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Twelfth Annual Report
OF THE
BOSTON WATER BOARD.



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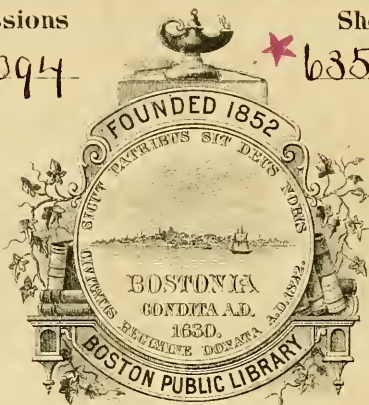
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TWELFTH ANNUAL REPORT

OF THE

BOSTON WATER BOARD,

FOR THE

YEAR ENDING DECEMBER 31, 1887.



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1887

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Boston Water Board

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Apr. 28, 1888

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BOSTON.

TWELFTH ANNUAL REPORT
OF THE
BOSTON WATER BOARD,
FOR THE
YEAR ENDING DECEMBER 31, 1887.

BOSTON WATER BOARD OFFICE,
BOSTON, January 1, 1888.

To the Honorable the City Council: —

The Boston Water Board present their Annual Report for the year ending Dec. 31, 1887.

A comprehensive summary of the revenue and expenditures of the Department for the calendar year may be made as follows: —

REVENUE.

Cochituate Department, income . . .	\$1,275,298 32
Mystic “ “ . . .	295,196 99
Proceeds of Construction, Extension, and Improvement Loans	589,625 19
	\$2,160,120 50

EXPENDITURES.

Cochituate Department, maintenance . .	\$342,246 93
“ “ construction, extension, etc. . .	589,625 19
“ “ interest on debt . .	721,584 76
“ “ required sinking-fund, . .	190,000 00
Mystic “ maintenance . .	153,345 02
“ “ interest on debt . .	44,927 50
“ “ refund of rates . .	84,374 47
Cochituate “ surplus (to sinking-fund), . .	21,466 63
Mystic “ “ “ “ “ “ . .	12,550 00
	\$2,160,120 50

The principal accounts, for the past two years, compare as follows : —

	1886.	1887.
Care and maintenance Co-chituate Department .	\$339,710 06	\$342,246 93
Care and maintenance Mystic Department . . .	134,616 85	153,345 02
Extension of mains . . .	175,069 46	343,903 15
Additional supply of water,	144,306 04	40,078 62
New high service . . .	141,085 56	160,866 80

As our appropriations are made for the financial, and not for the calendar year, no financial statement which we can make is so complete or satisfying for purposes of close comparison as that embodied in the City Auditor's Report ; but we append, in addition to the customary general tables of statistics, condition of debt, etc., some new tables, giving an account of our expenditures in classified form, and a list of contracts pending and completed during the year.

EXTENSION OF MAINS.

The work done under this head in 1887 exceeded that of any year since 1875. The demands of the outlying districts for new water service necessitated the laying of over twenty-two miles of mains, as against fourteen in 1886.

In addition to this, a portion of the work of laying an enlarged main to East Boston has been done ; a new pipe-box and fender has been built across Mystic river ; and a portion of the pipes for connecting the Cochituate system with Charlestown has been laid. The East Boston and Charlestown work will be completed the coming season.

New location and grades for Beacon street having been established by the town of Brookline, 1,528 feet of our 48-inch main, near the foot of Corey Hill, were taken up and a corresponding length of new pipes laid.

Sidewalk stop-cocks have been placed for over 6,000 services during the year, making the total number now set 25,000. These stop-cocks, as expected, prove very convenient and economical.

NEW HIGH SERVICE.

The new High Service Works approach completion. Fisher-hill reservoir is finished, and is already in service, water being pumped thereto from the Elmwood-st.

station. Ground was broken for the foundations of the new pumping-station at Chestnut Hill, in January last, and the several contracts for foundations, masonry, roofing, etc., have been advanced with the greatest possible despatch. The boilers are in place, one of the Gaskill engines is in readiness for use and the other is nearly so. It is expected that the steam connections will be made early in this month, and that within a few weeks pumping may actually begin. This will relieve us from any further apprehension of a failure of the high service supply through over-tasking the old pumps, and will also enable us very shortly to extend the area of this service to districts which have long needed it.

The appropriation for high service was \$766,000, of which \$511,000 has been expended. There will be required to meet outstanding contracts and to complete the service, including the extension of the East Boston high service to Breed's Island, not more than \$175,000.

All the purposes included in the estimates for the New High Service, excepting the purchases of land for Reservoir No. 3 (estimated at \$28,000), will be accomplished at a cost nearly \$170,000 less than the estimates. There have been, and are to be, charged to the appropriation, the expenses of objects not included in the estimates (viz., the extensions of the high service to West Roxbury, Charlestown, and Breed's Island), amounting to \$125,000. And when all these matters are completed, there will be, according to our present calculation, a balance remaining of at least \$70,000.

IMPROVEMENTS AT LAKE COCHITUATE.

Some important improvements have been begun at Lake Cochituate. Those portions of the lake where the brooks enter have remained shallow, and during the summer months have presented opportunity for the accumulation and generation of noxious elements in the water. Being authorized thereto by the City Council, we began the work of remedying this as early in the season as the lake could be safely drawn down. The inlets at Beaver Dam brook and Course brook, and a shallow cove near the inlet from Dug pond, have been excavated, abrupt gravelled banks have been substituted for muddy shallows, and in these localities we shall have deeper water, a better current, and other greatly improved conditions. The work so far done has cost about \$29,000.

The estimate for the whole work as contemplated¹ at the beginning of the season was \$40,000, and includes improvements on the "Pegan" meadow, which are to be made next

season. Upon drawing down the lake, we find that it will be desirable to extend the work to two or three localities not included in our original estimates, and we shall ask for authority to do so.

REMOVAL OF POLLUTIONS.

A year since we expressed a confident expectation that some schemes of sewerage for Framingham and Marlboro', beneficial to our water-supply, might soon be undertaken. We are glad to state that the town of Framingham obtained from the Legislature an act authorizing it to build a sewer system; and the City Council, having authorized us to arrange for a contribution to the cost of such a system, negotiations have been actively carried on, with a fair prospect of agreement in the near future. The Selectmen of the town of Marlboro' are now engaged in preparing a sewerage scheme for that town; and we expect an opportunity to negotiate with them within two or three months. In these two towns are located the greater part of the pollution cases which actively threaten injury to our main water-supply.

There is no obligation resting upon the city of Boston to assist towns in providing sewerage, except so far as the method of constructing and caring for their systems involves expense beyond what might be required if such system were arranged without reference to our water-supply. It is to be expected that the parties with whom we have to deal will claim no less than what is fully their due; but unless they persist in demands which are unreasonably large, we anticipate no serious difficulty or delay in making satisfactory arrangements.

In the absence of any movement in good faith by the town governments to adopt means of diverting the sewage, it would have been our duty to invoke the law in several cases. But, as the matter stands, it has appeared to be wise policy to avoid legal conflicts, and to encourage the town authorities to the adoption of such measures as we could legally assist in carrying out.

Even after the town systems of sewerage are established there will remain some highly important schemes for reducing pollution to be considered; but it is not expedient to take them up at present.

Constant surveillance in the Mystic District has enabled us to prevent any increase of polluting causes; but the general condition of the territory remains, and, for reasons heretofore stated, must remain, a menace to the quality of the water.

QUALITY OF THE WATER.

In our report for 1886 we submitted facts showing that the quality of the main supply (Cochituate and Sudbury) was excellent in itself, and superior to that of any large American city on the seaboard. We have only now to state that the quality has been maintained, and remains good. The Mystic supply appears, from the result of analyses, to have been, through the year, of about the same quality as last year, but from the nature of its surroundings, we not only can expect no improvement, but must anticipate a gradual deterioration.

The following memoranda of the results of analyses made for us near the close of the years 1886 and 1887, indicate that there is no material change in the chemical constituents of the waters.

	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	RESIDUE.			Hardness.
				Fixed.	Volatile.	Total.	
Boston (main supply) 1886	0.0000	0.0230	0.60	1.50	3.68	5.10	1
“ “ “ 1887	0.0015	0.0243	0.50	2.35	3.25	5.60	1½
“ (Mystic “ 1886	0.0628	0.0320	2.45	8.45	5.05	13.50	6
“ “ “ 1887	0.0334	0.0190	2.75	9.60	5.40	15.00	4½

(Figures express parts in 100,000. The above figures, as to main supply, are averages of analyses for October and January. The figures as to Mystic supply are for the closing analysis of the year. The summer analyses in this district show less ammonia, chlorine, and residue.)

The comment of Prof. E. S. Wood, our analyst, on analysis in October, is: “Basin 3, Sudbury river, Farm Pond, Lake Cochituate, and the service waters are in better condition than in October, 1885 or 1886; and that of Chestnut Hill reservoir better than in 1886.” Respecting a later analysis (for January, 1888), he says: “The waters of Stony Brook, Basin 3, Sudbury river, and Basin 4, are better than in January, 1887. Those from Farm Pond, Lake Cochituate, Chestnut Hill Reservoir, and Cold Spring Brook, are in about the same condition as in January, 1887.”

The State Board of Health have made periodical analyses of our waters, the results of which have been furnished us. They correspond closely with those made by Professor Wood. At the close of the year, they reported, as did Professor

Wood, a large increase of free ammonia in the Mystic water. This water seems to be subject to this variation during the winter.

In the course of a recent public address upon "The odor and color of Surface Waters," Prof. T. M. Drown, of the Institute of Technology, commended the Sudbury and Cochituate supply "for its stability and freedom from change in the condition in which it flows from the tap of the consumer." This observation was based on a series of analyses extending over several weeks, all of which, respecting the ammonias, showed better results than we have cited above.

The State Board have lately made some experiments in regard to bacteria. The results indicate a very satisfactory condition of things in that particular as to our main supply.

CONSUMPTION AND WASTE OF WATER.

In our last report we devoted considerable space to a consideration of this subject, and demonstrated that our average consumption (74 gallons per capita per day) was not unreasonably large by comparison with other large cities. It is to be expected that as cities grow the per capita rate will gradually increase, but we have cherished a hope that our consumption might not, at present, exceed a rate of seventy-five gallons. Our records show a consumption in the Mystic District of 72 gallons, and in the Cochituate department of 80 gallons. We do not regard the latter as a permanent rate, for, owing to causes not yet fully ascertained, the consumption during several months was exceptionally large, and later has resumed more normal proportions.

The systems of checking waste heretofore prevailing have been continued. They serve to bring to early notice important leaks in the mains, and also to prevent householders and others from long-continued maintenance of leaky and wasteful fixtures. One fact is established by the experience of the past year, that there is, in strictly domestic consumption, a perceptible augmentation. The cases where any dwelling-house section showed a reduced consumption were very rare.

METERS.

By reference to the report of the Superintendent of the Meter Division it will be observed that the number of meters in service is less than last year. It has been found necessary to remove a large number of meters which had proved inefficient, and the replacements have not equalled the removals.

Many of the meters had been in continuous use for years. These were taken out, tested, and if found worthless, replaced by new meters ; or, if found fit, with repairs, for further service, again put in use. Many cases were found where the consumer was reaping the benefit of great errors in the meter. The net result of this overhauling is that, notwithstanding the rates for metered water have been within two years reduced ten per cent., and the number of meters has been in the same time reduced twenty per cent., the revenue from this class of services has largely increased. This indicates a greatly improved condition of efficiency in the meters and in the meter division.

Last spring we entered upon the task of making a full test of such water-meters as might be offered. The tests were begun April 25 and concluded in October. Our reasons for engaging in this test were these : —

The city has heretofore expended large sums for water-meters, many of which have proved unreliable. Whether or not it will ever be expedient to procure meters in large numbers, it will be necessary from year to year to procure certain quantities to replace those worn out and proved inefficient, and to meet new requirements. Numerous new inventions are offered with claims of superior merit, but about which the ordinary tests fail to supply a basis for a sound opinion. All "tests" of which we have any knowledge have been very superficial ; and, in fact, every city about to purchase meters has been reduced to the choice of taking a meter because other people are using it ; *i.e.* it has had a "large sale" ; or of accepting the opinion of an engineer or other superintending officer, who may or may not be qualified to make a selection, and who may or may not be wedded to some pet theory. There is, and has been, no such thing as a settled or accepted judgment on the merits of the mechanical principles involved in the different styles brought to the public attention.

The construction of a "perfect" water-meter — accurate and durable under all conditions — is acknowledged to have presented more difficulties to the inventor than almost any other problem in mechanics ; and there are those who still maintain that the thing cannot be done, except approximately. Yet there have been meters in the market for years which enjoy a fair reputation ; and the claims of the later inventors are loud and persistent. It has been often said that there was no way of surely testing a meter except by a period of long service ; and it was open to us to take a quantity of each of the most promising inventions, to put them in service in different localities and under all conditions, and

await results. This would have been a tedious process, entailing in itself considerable expense; and we felt that, in view of the known and possible future wants of the city, we ought to try a more thorough, and at the same time more expeditious, method.

We therefore committed the matter to Messrs. L. Fred. Rice, Charles Carr, and N. M. Lowe (two engineers and one expert inventor, and all men of high repute in their way), to make exhaustive experiments. The number of meters presented for examination was fully double what we anticipated, and the work was necessarily prolonged; but the report is expected within a short time.

We are not informed, even in a general way, of the conclusions which will be presented to us; but we feel certain that they will enable us at least to avoid repeating the waste involved in some past transactions; and we hope that they may be of such a character as to guide us, sooner or later, to the selection of machines both sound in principle and reliable in practice. It will be interesting to compare the results reached with those recorded through a series of years by the department. Our experience has developed defects, of one kind or another, in nearly all the meters we have had in use; and if, as we anticipate, these tests supplement our experience with an elucidation of the scientific or mechanical causes which underlie the defects noted, we shall be greatly assisted in endeavoring to limit our selections to the kinds which indicate the closest approach to perfection. It is to be expected that the opinions expressed will meet with wide discussion,—in some cases perhaps with dissent,—but, in the end, we feel that results will be reached of great value, not only to ourselves, but to the interest of all water-works.

An impression has gone abroad that a large extension of the meter system is contemplated. So far as this Board is concerned that impression is unfounded. At present we do not need many more meters than are now in service; but we shall need to replace a good many that will from time to time be taken out on account of age or infirmity. With the natural increase of services of all kinds, there will be some increase of meters required; but the time has not arrived, in our judgment, for the adoption of an enlarged scheme of meter service. The occasion for what may be called a "general" meter service can only exist in such cities as are compelled to maintain high water-rates; or in such cities as are constrained to carry their economy of supply to the point of parsimony. Boston is at present in neither category.

WATER FOR CHELSEA, SOMERVILLE, AND EVERETT.

The joint application to the Legislature of 1887, by the cities of Boston, Chelsea, and Somerville, and the town of Everett, for a grant of the waters of the Shawshine river, was denied. The case was clearly presented to the committee, which considered it. It was shown that the Mystic supply would at an early day be insufficient in quantity, and might soon be unfit for domestic use; it was shown that the capacity of the Shawshine river was equal to the demands of 300,000 people, and that by the time the population of the Mystic district reached that point, the proportional interest of the City of Boston (or, specifically, Charlestown) would be not more than one-sixth of the whole; and it was thus demonstrated that for Chelsea, Somerville, and Everett the "water question" was a matter of vital importance, to be met by getting the Shawshine river, *or some other supply*, without delay. The committee were convinced, and reported a bill to the Legislature. It was there supported with some earnestness by a portion of the Representatives of the places interested, and half-heartedly by others. We regret to say that many Boston Representatives were indifferent, and some actively opposed the measure. A misinterpretation of the relations of Boston to Chelsea, Somerville, and Everett—to the effect that we should be bound in law or equity to give them water from our Cochituate supply, in case of failure of the Mystic supply—was industriously fostered and circulated, and found credence. Finally, the bill was rejected.

We have taken no measures to revive the question before the Legislature of 1888. Having for two successive years labored earnestly for the advantage of communities which have failed thus far to give the project that hearty and united support which is necessary to bring success, we have deemed it wise to make no further effort now. If Chelsea, Somerville, and Everett shall take the initiative, and bestir themselves as they ought, we shall be glad, if the help of Boston can avail them anything, to lend our cordial aid.

But, as to alternatives, we see no reason why we should not be out-spoken here, as we have been in our private conferences with the interested parties. If they think, or can be brought to think, that the Mystic system would, if relieved of the necessity of supplying Charlestown, serve their purpose for a term of years; and that, with the Mystic Water-Works in their hands, they could afford to take the chances of that term of years, and of thereafter getting the Shawshine or some other supply to eke out their wants, we should be ready to recommend the City

Council to take measures for the transfer of the Mystic Water-Works to their ownership. We are ready to dissolve partnership on the most favorable terms. They have no claim whatever upon Boston, except for Mystic water, and Boston has no other water to sell them. Within a few years Boston will be confronted with the prospective exhaustion of its own supply, and will be seeking a new one. The communities named ought to realize the position they are placed in, and act. We have sounded repeated notes of warning, and otherwise done, perhaps, more than our duty. For the present we drop the subject.

RESERVOIR NO. 5.

By authority of the City Council we have made purchases of land on the borders of Indian brook in Hopkinton and Ashland for a site for a new reservoir. We have acquired 310 acres, for \$20,316, which, allowing for value of farm-houses and buildings, makes the average cost of land about \$60 an acre. About 100 acres more remain to be obtained, respecting which arrangements are pending.

We renew our recommendation that the construction of this reservoir be proceeded with at once. While we do not present the matter as one of paramount necessity, we feel that the reasons heretofore adduced are sound, that we ought to be prepared for all accidents of interruption to, or injury of our supply. It will require five years to build the basin, fill it, and have its contents fit for use; and by that time our demands will reach about 90 per cent. of the supply which is available to-day. A larger margin will certainly put us in a safer and more comfortable condition.

NEW APPROPRIATIONS.

Excepting for the proposed new reservoir, and for the customary appropriations for extension of mains, we do not anticipate any necessity for new appropriations this year. It is probable that we may ask that provision be made for enlarging, by transfer, the amounts of one or two of the existing minor appropriations; but with reference to these matters, special communications will be made to the City Council, when our plans are further matured.

We have in hand an application from the Board of Directors for Public Institutions for an extension of the service to Long Island. The necessity therefor is represented as urgent. The City Engineer has furnished us with estimates of the cost, and we shall shortly bring the matter to the notice of the City Council.

We refer to reports of the City Engineer, the Water Registrar, and the several Division Superintendents, for details of interest respecting the transactions of the department.

Respectfully submitted,

HORACE T. ROCKWELL,
WILLIAM B. SMART,
THOMAS F. DOHERTY,

Boston Water Board.

General Statistics.

SUDBURY AND COCHITUATE WORKS.	1885.	1886.	1887.
Daily average consumption in gallons . . .	25,607,200	26,627,900	29,852,100
Daily average consumption in gallons per inhabitant	72.4	74.3	80.7
Daily average amount used through meters, gallons	6,186,668	6,373,200	7,229,700
Percentage of total consumption metered .	24.2	23.9	24.1
Number of services	51,810	53,400	55,235
Number of meters and motors	4,417	3,763	3,393
Length of supply and distributing mains, in miles	400	414	436.5
Number of fire-hydrants in use	4,681	4,806	4,990
Yearly revenue from water-rates	\$1,239,757 99	\$1,206,064 69	\$1,244,191 75
Yearly revenue from metered water	\$452,961 60	\$400,706 85	\$451,335 09
Percentage of total revenue from metered water	36.5	33.2	36.3
Cost of works on Jan. 1, 1886, 1887, and 1888,	\$18,567,279 19	\$18,973,616 03	\$19,527,483 32
Yearly expense of maintenance	\$321,137 26	\$336,507 37	\$339,693 34
MYSTIC WORKS.			
Daily average consumption in gallons . . .	6,737,350	7,399,800	7,629,000
Daily average consumption in gallons per inhabitant	67.9	72.5	72.7
Daily average amount used through meters, gallons	1,012,755	1,117,600	1,248,200
Percentage of total consumption metered .	15.0	15.1	16.4
Number of services	15,928	16,110	16,809
Number of meters and motors	594	469	428
Length of supply and distributing mains, in miles	131.0	133.2	136.1
Number of fire-hydrants in use	781	818	935
Yearly revenue from water-rates	\$276,557 60	\$249,609 62	\$293,018 65
Yearly revenue from metered water	\$74,128 87	\$69,330 48	\$76,241 82
Percentage of total revenue from metered water	26.8	27.8	26.0
Cost of works on Jan. 1, 1886, 1887, and 1888,	\$1,656,805 39	\$1,637,458 97	\$1,659,639 37
Yearly expense of maintenance	\$122,858 00	\$134,439 43	\$153,345 02

EARNINGS AND EXPENDITURES.

The total receipts of the Cochituate Water-Works from all sources for the year ending December 31, 1887, were as follows, viz. : —

Income from sales of water	\$1,244,191 75
Income from shutting of and letting on water, and fees	3,036 00
Elevator, fire and service pipes, sale of old materials, etc.	28,070 57
	\$1,275,298 32

The total expenditures of the Cochituate Water-Works for the year ending December 31, 1887, were as follows, viz. : —

Current expenses	\$339,693 34
Refunded water-rates	553 59
Transferred to City Collector's Department	2,000 00
Interest on funded debt	721,584 76
	\$1,063,831 69
Balance Dec. 31, 1887	\$211,466 63

The total receipts of the Mystic Water-Works, from all sources, for the year ending December 31, 1887, were as follows, viz. : —

Income from sales of water	\$293,018 65
Income from shutting off and letting on water, and fees	328 75
Service-pipes, repairs, etc.	1,849 59
	\$295,196 99

The total expenditures of the Mystic Water-Works for the year ending December 31, 1887, were as follows : —

Current expenses	\$153,345 02
Interest on funded debt	44,927 50
Refunded water-rates	470 83
Amount paid Chelsea, Somerville, and Everett, under contract	83,903 64
	282,646 99
Balance Dec. 31, 1887	\$12,550 00

COST OF CONSTRUCTION, AND CONDITION OF THE WATER DEBTS.

Cost of construction of Cochituate Works	
to Jan. 1, 1887	\$18,973,616 03
Transfer sidewalk Stopcock } account : (Special Appropriation of } Jan. 4, 1884) . . . }	\$50,000 00
Expended in 1887, as follows, viz. : —	
Extension of Mains, etc.	\$302,921 87
New High-Ser- vice Works, ...	160,866 80
Additional sup- ply of water, ...	40,078 62
	503,867 29
	553,867 29

Cost of construction of Cochituate Water Works, to Jan. 1, 1888	<u>\$19,527,483 32</u>
--	------------------------

The outstanding Cochituate Water Loans, Jan. 1, 1887, were		\$13,890,273 98
Issued during year 1887, as follows : —		
Appropriation, High Service, 4% Loans	\$349,700 00	
“ { Extension of Mains, etc. : —		
“ { 3% Loans, \$200,000		
“ { 3½% “ 150,000		
		350,000 00
“ Additional supply of Water, 3½% Loans	35,000 00	
“ Protection of Water Supply, 3½% Loans, ...	50,000 00	
“ Improvement of Lake Cochituate, 3½% Loans	40,000 00	
		824,700 00
Total Cochituate Debt, Jan. 1, 1888		<u>\$14,714,973 98</u>

Cochituate Water Sinking Fund, Jan. 1,	
1887	\$3,853,269 61

Cochituate Water Sinking Fund, Jan. 1,	
1888	4,271,168 59

Net Cochituate Water Debt, Jan. 1, 1887,	10,037,004 37
“ “ “ “ “ 1, 1888,	<u>10,443,805 39</u>

Cost of construction of Mystic Works to	
Jan. 1, 1887	\$1,657,458 97
Cost of construction of Mystic Works to	
Jan. 1, 1888	<u>1,659,639 37</u>

The outstanding Mystic Water Loans, Jan.	
1, 1887, were	\$839,000 00
Redemption of Debt, due October 1, 1887,	
(6% Loans)	50,000 00
	<u>\$789,000 00</u>

Renewal of Debt due Oct. 1, 1887 ($3\frac{1}{2}\%$	
Loans)	50,000 00
	<u>\$839,000 00</u>

Total Mystic Debt, Jan. 1, 1888 . . .	<u>\$839,000 00</u>
---------------------------------------	---------------------

Mystic Water Sinking Fund, Jan. 1, 1887,	\$594,639 00
“ “ “ “ “ 1, 1888,	655,133 52

Net Mystic Water Debt, Jan. 1, 1887 .	244,361 00
“ “ “ “ “ 1, 1888 .	<u>183,866 48</u>

EXPENDITURE ACCOUNTS.

JANUARY DRAFT, 1887, TO JANUARY DRAFT, 1888.

Extension of Mains:—

Labor	\$93,455 45	
Salaries	1,798 27	
Teaming	7,322 75	
Blasting	12,050 06	
Water-pipes, Contracts	160,622 81	
Miscellaneous	7,002 89	
Stock	60,950 92	
		\$343,703 15

High Service:—

Labor	\$15,789 94	
Teaming	1,167 99	
Salaries	5,125 61	
Stock	9,213 48	
Blasting	977 67	
Water-pipes, Contract	4,350 09	
Fisher-Hill Reservoir, Contract	38,223 11	
West Roxbury Pumping-Station Contract	2,852 50	
Wrought-iron Tank, Contract	2,650 00	
Foundations, New Pumping-Station, Chestnut Hill, Contract	31,833 68	
Freestone, New Pumping-Station, Chestnut Hill, Contract	12,500 00	
Land purchased	400 00	
Masonry, New Pumping-Station, Chestnut Hill, Contract	19,000 00	
Gate-House, Fisher-Hill Reservoir, Contract	8,000 00	
Dwelling-house, Contract	1,000 00	
Boilers, New Pumping-Station, Chestnut Hill, Contract	3,000 00	
		\$160,866 80

Introduction of Meters and Inspection:—

New Meters	\$11,576 15	
Stock for Meter supplies	1,240 21	
Expenses of Special Water-Meter Test—		
Salaries of Commissioners, etc.	5,863 25	
Stock and expenses	1,852 11	
Labor	2,028 24	
		\$22,559 96

Improvement of Lake Cochituate:—

Labor	\$19,193 58	
Salaries	940 00	
Travelling expenses	505 05	
Teaming	1,272 88	
Stock, tools, and expenses	1,005 15	
		\$22,916 66

Additional Supply:—

Salaries (Engineers')	\$5,871 72	
Labor	451 53	
Materials and expenses	3,090 27	
Contracts for work on Shallow Flowage	10,221 35	
Teaming	143 75	
Land purchased for Basin V.	20,300 00	
		\$40,078 62

MAINTENANCE ACCOUNTS, COCHITUATE WATER-WORKS.

Boston Water Board:—

Salaries of two Commissioners, four Clerks, and Messenger	\$13,271 24	
Travelling expenses and miscellaneous	1,752 82	
Printing and stationery	662 23	
Advertising and postage	485 18	
		\$16,171 47

Water Registrar's Department:—

Salaries of Registrar, ten Clerks, seven Inspectors, Foremen, Marine Agent, and laborers in Service Division	\$40,873 01	
Travelling expenses and miscellaneous	1,538 29	
Printing and stationery	1,398 37	
Advertising and postage	85 60	
		43,895 27

Eastern Division:—

Salaries of Superintendent, Clerks, and Foreman	\$6,750 74	
Travelling expenses and transportation of men	1,852 33	
Printing and stationery	551 76	
Miscellaneous	152 51	
		9,307 34

Western Division:—

Salaries of Superintendent, Assistant Superintendent, Clerks, and Special Agent	\$9,313 39	
Travelling expenses	1,144 59	
Printing and stationery	428 91	
Miscellaneous	128 55	
		11,015 44

Amount carried forward, \$80,389 52

<i>Amount brought forward,</i>	\$80,389 52
<i>Inspection and Waste Division: —</i>	
Salaries of Superintendent, three Clerks, and Inspectors	\$33,198 20
Travelling expenses	980 70
Printing and stationery	364 53
Miscellaneous	25 25
	34,568 68
<i>Meter Division: —</i>	
Salaries of Superintendent, one Foreman, and one Clerk	\$4,283 46
Travelling expenses	160 61
Printing and stationery	51 92
New meters	429 38
Setting and repairing	12,302 68
Stable	873 88
Tools and miscellaneous	764 65
	18,866 58
<i>Federal-st. Yard: —</i>	
Workshop, blacksmith shop, etc.	5,035 13
<i>Albany-st. Yard: —</i>	
Pipe yard, stable, etc.	8,889 52
Maverick Wharf (depot for furnishing water to shipping), rent, and salary of agent	2,020 00
Telephones	779 81
Special agents' (2) salaries, travelling expenses, etc.,	2,440 92
Cochituate Aqueduct	2,996 66
Sudbury Aqueduct	10,828 43
Main pipe relaying (including stock and labor)	21,808 03
“ “ repairing “ “ “ “	7,115 27
Hydrants “ “ “ “ “	19,076 65
Stopcocks “ “ “ “ “	3,401 86
Hydrant and stopcock boxes, and repairing (including stock and labor)	5,463 58
Tools and repairing (including stock and labor)	7,604 69
Streets “ “ “ “ “	6,484 74
Fountains “ “ “ “ “	2,574 96
Stables “ “ “ “ “	8,201 07
Waste detectors “ “ “ “ “	9,846 66
Main-pipe cleaning “ “ “ “ “	9,748 69
Basins, Framingham and Ashland (including stock and labor)	5,989 03
Service-pipe repairing (including stock and labor),	13,772 49
High service, Roxbury, including fuel, salaries, re- pairs, etc.	12,186 89
<i>Amount carried forward,</i>	\$300,089 86

<i>Amount brought forward,</i>	\$300,089 86
High service, East Boston (including fuel, salaries, repairs, etc.)	3,189 42
High service, Brighton (including fuel, salaries, repairs, etc.)	3,148 74
High service, West Roxbury (including fuel, salaries, repairs, etc.)	2,343 46
Chestnut-Hill Reservoir (including stable, care of grounds, etc.)	12,851 10
Parker-Hill Reservoir	1,611 18
Brookline Reservoir	1,694 18
East Boston Reservoir	591 45
South Boston Reservoir	110 55
Lake Cochituate	4,759 20
Chestnut-Hill driveway	2,038 51
Collector of Water-rates, salary	2,499 34
Taxes	781 94
Damages	881 06
Analysis of water, etc.	350 00
Merchandise sold (pipes and castings, in cases of emergency)	2,753 35
	\$339,693 34

MAINTENANCE ACCOUNTS, MYSTIC WATER-WORKS.

Boston Water Board:—

Salaries of one Commissioner and one assistant clerk	\$4,226 00
Printing and stationery	94 33
Advertising and postage	158 96
Travelling expenses and miscellaneous	171 30
	\$4,650 59

Water Registrar's Department:—

Salaries of Deputy Collector, two Clerks, and three Inspectors	\$8,321 69
Printing and stationery	516 27
Travelling expenses	142 35
Advertising, postage, and miscellaneous, ...	411 03
	9,391 34

Superintendent's Department:—

Salaries of Superintendent, Assistant Superintendent, and Clerk	\$5,445 19
Printing and stationery	114 12
Travelling expenses	97 32
Miscellaneous	79 69
	5,736 32

<i>Amount carried forward,</i>	\$19,778 25
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<i>Amount brought forward,</i>		\$19,778 25
<i>Inspection and Waste Division:—</i>		
Salaries of Inspectors	\$9,200 91	
Travelling expenses	193 69	
Printing and stationery	103 72	
		9,498 32
<i>Meter Division:—</i>		
New Meters	\$83 46	
Setting and repairing	6,031 68	
Tools	42 31	
Stable	519 34	
Travelling expenses and miscellaneous	120 12	
		6,796 91
Off and on water (labor)		2,852 76
Main-pipe laying (including stock and labor)		2,180 40
“ relaying “ “ “		7,842 44
“ repairing “ “ “		1,116 02
Service-pipe laying “ “ “		929 07
“ “ repairing “ “ “		3,108 17
Hydrants and gates, repairing“ “ “ “		3,714 73
Streets “ “ “ “		550 91
Lake		7,505 22
Conduit		2,574 28
Engine-house		8,607 28
Stables		8,369 37
Reservoir		2,625 75
Pumping-service, salaries and wages	\$8,261 20	
Fuel	14,183 60	
Repairs	2,507 89	
Oils, waste, and packing, and small supplies	3,559 80	
		28,512 49
Repair-shop and pipe-yard		2,750 20
Fountains		771 53
Tools and repairing		2,202 15
Taxes		143 71
Mystic Sewer (repairs, and pumping, and treatment of sewage)		16,453 35
Temporary pumping-works at lake		362 88
Waste detector service		1,276 97
Mystic-Valley surveys		2,302 46
Connections with Cochituate Service		10,257 68
Merchandise sold		261 72
		<u>\$153,345 02</u>

List of Contracts, Made and Pending, During 1887.

NOTE. — The contracts marked with a star (*) are completed.

Contractors.	Date.	Work.	Amount.	Amt. paid.	Extra Work.
*Moulton & O'Mahoney	Oct. 7, 1885.	High-Service Reservoir, Fisher Hill	\$75,606.30	\$75,967 27	\$289 40
*Robert R. Mayers & Co.	" 18, "	Gate-house, Basin IV., Ashland	\$2,725.00	2,782 00	57 00
*Geo. F. Blake Mfg Co.	Aug. 2, 1886.	Two High-service pumps, West Roxbury	\$2,172.00	2,299 56	127 56
Holly Mfg Co.	" 14, "	Two 8-million gallon pumps, High-service	\$50,000.00	17,500 00	
*Gloucester Iron Works	Jan. 25, 1887.	Pipes and specials (quantities increased about twenty per cent., agreeable to terms of contract)	\$88,331.40 (estimated)	105,275 09	
Jeremiah Carew	" 21, "	Freestone, new Pumping-Station	\$21,636.00	17,500 00	
*Edward Kendall & Sons	Feb. 21, "	Wrought-iron pipe, Chestnut-Hill avenue bridge	\$528.00	528 00	
*Collins & Ham	Mar. 2, "	Foundations and chimney, Chestnut-Hill Pumping-Station, ...	\$30,682.50	35,235 31	4,220 23
*R. D. Wood & Co.	" 2, "	Pipes and Specials, High-service	Pipes, \$33.75; Specials, \$68.40 ton.	4,656 71	
*John Coleman	" 3, "	Blasting, Glen road, Dorchester	\$3.85 per cubic yard	185 49	
Wm. Curley	" 28, "	Brass and composition castings	Brass, 13½c.; composition, 15½c. lb.	3,656 19	
Samuel B. Locke & Co.	" 29, "	Iron castings	2.15-100c. lb.	7,911 25	
Samuel B. Locke & Co.	" 29, "	Service-box castings	2.25-100c. lb.	6,790 65	
Donahue Bros.	April 5, "	Masonry, Chestnut-Hill Pumping-Station	\$42,990.00	29,000 00	
*John Coleman	" 6, "	Blasting, Richfield street, Dorchester	\$3.60 per cubic yard	72 72	
*Samuel B. Locke & Co.	" 15, "	Chimney-castings, etc., Pumping-Station	3½c. lb.	603 40	
*John Coleman	" 25, "	Blasting, Bellevue terrace, Dorchester	\$3.80 per cubic yard	601 48	
George Miles	May 6, "	Boilers for High-service	\$5,928.00	3,000 00	
John French	" 19, "	Gate-house, Fisher-Hill Reservoir	\$8,912.00	8,000 00	

List of Contracts, Made and Pending, During 1887.— *Concluded.*

Contractor.	Date.	Work.	Amount.	Amt. paid.	Extra Work.
*Timothy Gunning	May 21, 1887.	Blasting, Willow street, West Roxbury	\$3.75 per cubic yard	\$447 75	
*John Coleman	June 2, "	" Walkhill avenue, West Roxbury	\$3.90 per cubic yard	220 74	
*Dennis O'Connell	" 4, "	" Washington street, Dorchester	\$3.30 " "	153 12	
S. M. Hamilton & Co.	" 9, "	Cumberland coal, Mystic Water-Works	\$3.89 per ton	8,458 00	
*Camden Iron Works	" 11, "	Water-pipes and Specials	48 in. 30-in. 24 in. \$34.00; \$34.50; \$35.00 per ton .	63,789 50	
*Timothy Gunning	" 30, "	Blasting, Montrose street, Roxbury	\$3.50 per cubic yard	164 85	
*Dennis O'Connell	July 20, "	" Centre and Grove streets, West Roxbury	\$5.50 " "	804 60	
*Dennis O'Connell	" 20, "	" Washington and Rockland streets, W. Roxbury	\$5.50	1,320 00	
*Dennis O'Connell	" 20, "	" German and Grove streets, West Roxbury	\$5.50	1,163 80	
*John Coleman	" 21, "	" Thwing terrace, Roxbury	\$3.50 per cubic yard	231 00	
*Timothy Gunning	" 26, "	" Westville street, Dorchester	\$3.90 " "	279 63	
*Z. E. Coffin, Agent	Aug. 4, "	Sluice-gates, etc., for High-service works	\$10,717 00	10,745 99	\$23 99
*John Coleman	" 8, "	Blasting, Cass street, West Roxbury	\$4.90 per cubic yard	80 85	
*B. C. Thinkham	" 12, "	" Humboldt avenue, West Roxbury	\$4.15 " "	314 99	
*James McLaughlin	" 17, "	" Hillsdale and Richview streets, Dorchester	\$3.45 " "	76 59	
*Timothy Gunning	" 22, "	" Howland street, Roxbury	\$4.00 " "	111 20	
*Timothy Gunning	" 26, "	" Walnut avenue, Roxbury	\$4.25 " "	893 25	
J. N. Hayes & Co.	" 29, "	Rebuilding pipe-box and fender, Chelsea bridge	\$14,500.00	6,527 15	
Cofredo & Saylor	Sept. 9, "	Iron roofs, Chestnut-hill Pumping-Station	\$6,750.00		

Boynnton Bros.	Sept. 12, 1887.	Rebuilding sea-wall, Albany-st. yard	\$9,974.00	\$6,527 67
*John Coleman	" 12, "	Blasting, Roxbury avenue, Brighton	\$4.70 per cubic yard	232 18
Daniel M. O'Connell	" 13, "	Dwelling-house, Chestnut-hill Pumping-Station	\$4,331.00	2,000 00
Gloucester Iron Works	" 21, "	30-in. pipe, 800 tons; 16-in. pipe, 430 tons; Specials, 100 tons	\$45,443.20 (estimated)	
Walworth M'fg Co.	" 21, "	Steam-piping, etc., Chestnut-hill Pumping-Station	\$1,287.00	
Cofrode & Saylor	" 29, "	Iron roof, engine-house, Chestnut-hill Pumping-Station	\$9,860.00	
*James McLaughlin	Oct. 12, "	Blasting, Sparrow street, West Roxbury	\$4.75 per cubic yard	109 73
*John Coleman	" 27, "	Blasting, Bellevue street, Dorchester	\$5.40 per cubic yard	98 28
McNeal Pipe and Foundry Co.	Nov. 4, "	Water-pipes and Specials	\$92,477.50 (estimated)	
Atlantic Works	" 10, "	Flue-beater, Chestnut-hill Pumping-Station	\$1,720.00	
John Farquhar's Sons	" 14, "	Roofing, Chestnut-hill Pumping-Station	\$4,000.00	
Michael Leonard	" 14, "	Blasting, Cass street and Oak avenue, West Roxbury	\$5.50 per cubic yard	
Edward Marley & Bros.	" 16, "	Copper-work, Chestnut-hill Pumping-Station	\$1,393.00	165 50
*Timothy Gunning	" 22, "	Blasting, Granite avenue, Dorchester	\$5.00 per cubic yard	
B. C. Tinkham	Dec. 5, "	Blasting, Hazelwood street, Roxbury	\$3.49 per cubic yard	
Patrick Grace	" 6, "	Blasting, Seaver street, Roxbury	\$4.50 per cubic yard	
*John Coleman	" 6, "	Blasting, Parsons street, Brighton	\$4.40 per cubic yard	110 00

REPORT OF CITY ENGINEER.

OFFICE OF CITY ENGINEER,
CITY HALL, BOSTON, January 27, 1888.

COL. H. T. ROCKWELL, *Chairman Boston Water Board*:—

SIR, — In accordance with the requirements of the revised ordinances I respectfully submit the following report on the condition of the Water-Works:—

THE SOURCES OF SUPPLY.

The rainfall of the past year was somewhat below the average, but occurred at such seasons that the percentage collected was large; consequently the amount of water received in the storage reservoirs has been larger than for any year since 1878. The rainfall and quantities collected have been as follows:—

	Sudbury.	Cochituate.	Mystic.
Rainfall, inches,	42.705	41.58	46.42
“ collected inches,	24.227	23.47	22.17
Daily average yield,			
gallons	86,749,300	21,089,200	28,376,600

The rainfall having been quite evenly distributed throughout the year there has been no scarcity of water at any time, and the storage reservoirs have been kept nearly full for the greater portion of the year. Very little trouble has been experienced from the growth of algæ, and the quality of the water, with the exception of that of the Mystic supply, has been good.

The fluctuations of the different reservoirs are graphically shown by diagrams facing page 46, and the condition of the several reservoirs during the year is given more in detail in the following statements:—

SUDBURY-RIVER RESERVOIRS AND LAKE COCHITUATE.

Reservoir No. 1.—Water was wasted over the crest of dam No. 1, from January 1 to May 25, 1887. Both sets of flash-boards were then put on the dam and the reservoir allowed to fill.

On June 2 waste began again, and continued until June 26, with the exception of three days. Between November 16 and November 23 water was drawn into Farm pond, and on November 25 the reservoir surface stood at 156.62, the lowest point reached during the year. On December 11 the water had risen to the level of the stone crest, and has been wasting since that date.

Reservoir No. 2.—This reservoir remained full from the beginning of the year until the middle of June, and water was running over the crest of the dam during the greater portion of that time.

On July 18 the surface had fallen about 4 feet, and during July and August it was from $2\frac{1}{2}$ to 3 feet below the top of the flash-boards. In September the water was falling; on October 4 it reached its lowest point for the year,—160.32 above tide-marsh level, or 6.80 below the top of the flash-boards; and on December 14 it was level with the stone crest of the dam.

On January 1, 1888, the water stood at 165.94 above tide-marsh level.

Reservoir No. 3.—This reservoir was full and overflowing on January 1, 1887. On January 8 the waste-gates were opened, and on February 2 the reservoir was empty. The gates were closed on February 10; on the 21st waste began over the dam, and continued until June 13, after which date the water surface gradually fell until October 4, when it stood at 171.73, or 3.51 feet below the stone crest of the dam. On December 6 the reservoir was again full, and since that date water has been wasting over the dam.

Reservoir No. 4.—On January 1, 1887, the water surface stood at 205.93 above tide-marsh level, or about 10 feet below high-water mark. On February 1 it had risen to 211.33, and it was kept near that level until the middle of March, when the waste-gates were closed and the reservoir allowed to fill. On March 28 waste began over the stone crest of the dam, and continued, with the exception of about two weeks in July and six days in August, until September 21st. From October 4 to November 15 water was drawn from this reservoir for the city's supply, lowering its surface about 10 feet to 204.98. The reservoir is now slowly filling, standing at 207.82 on January 1, 1888.

Farm Pond.—The average level of this pond for the year has been 149.24, and its surface has been kept within three or four inches of that elevation. Algæ appeared in the pond in June, and from June 2 to August 24 no water was taken from it, the supply for the city being taken through the new conduit across the pond.

The Framingham Water Co. has drawn from the pond during the year 87,500,000 gallons.

Lake Cochituate. — On January 1, 1887, the lake surface was 129.77 feet above the tide-marsh level, or 4.59 feet below high-water mark; it remained about grade 130 until January 24, when it rose rapidly. The stop-planks were removed, and waste began on January 29. Waste was continued during the greater portion of the time until May 9, when the stop-planks were replaced. The surface then fell slowly until July 29, when the waste-gate was opened for the purpose of more rapidly lowering the water, in order to facilitate the work of improving the shallow portion of the lake. The lowest point reached was 125.12, on November 10, and on January 1, 1888, the surface stood at 125.63. Early in September the water in the lake having fallen sufficiently, work was begun upon the improvement of certain portions of the lake in the vicinity of the Boston and Albany Railroad. The troubles occurring in this part of the lake have been already alluded to in previous reports. It was determined to deepen the water in certain places and to fill the margins in others, as has already been done in the reservoirs on the Sudbury river. The work was divided into six sections. The first of these extended north of the railroad in the valley of Beaver Dam brook. The fourth section was in the vicinity of the entrance of Course brook into the lake, and still another section adjacent to the Natick cemetery. These were all completed in accordance with the plans made the previous winter, and on December 20 the men were discharged and the water raised in this portion of the lake by putting in the stop-planks at the circular dam. The whole work was done by day's labor. The new banks were covered with clean gravel, supplied by the Boston and Albany Railroad Co. About 50,000 cubic yards of material were handled, of which 7,000 were gravel. The remainder was principally mud and peat. Plans will be made during the present winter for continuing this work in the Pegan meadows on the northerly side of the railway.

No water has been received in the lake from the Sudbury river or Dudley pond during the year. The following table shows the heights of the different reservoirs on the first of each month: —

	Reservoir No. 1. Top of flash- boards. 159.29.	Reservoir No. 2. Top of flash- boards. 167.12.	Reservoir No. 3. Crest of dam, 175.24.	Reservoir No. 4. Crest of overflow, 214.21.	Farm Pond.	Lake Co- chituate. Top of flash- boards. 134.36.
January 1, 1887	157.98	166.13	175.54	204.93	149.28	129.77
February 1, "	158.92	163.80	160.20	211.33	149.28	133.42
March 1, "	158.12	166.25	174.00	211.13	149.21	133.16
April 1, "	158.32	166.40	175.51	214.70	149.35	133.82
May 1, "	158.51	166.48	176.02	214.87	149.33	134.29
June 1, "	159.17	167.22	175.40	215.10	149.27	133.97
July 1, "	159.24	165.89	175.00	214.91	149.14	133.35
August 1, "	158.89	164.21	173.70	214.91	149.31	131.45
September 1, "	159.10	165.73	173.71	214.95	149.39	127.34
October 1, "	158.86	160.59	171.89	214.75	149.26	125.99
November 1, "	158.63	161.44	172.36	208.25	149.23	125.38
December 1, "	156.87	165.59	174.84	205.80	149.24	125.39
January 1, 1888	157.79	165.94	175.46	207.89	149.24	125.63

Water has been drawn from the Sudbury-river reservoirs for the supply of the city as follows: —

January 1 to February 25 inclusive, from Res. No. 2.
 February 26 to April 9 inclusive, from Res. Nos. 2 and 3.
 April 10 to April 24 inclusive, from Res. No. 2.
 April 26 to April 27 inclusive, from Res. Nos. 2 and 3.
 April 28 to May 20 inclusive, from Res. No. 2.
 May 20 to May 23 inclusive, from Res. Nos. 2 and 3.
 May 23 to May 27 inclusive, from Res. No. 2.
 May 27 to May 30 inclusive, from Res. Nos. 2 and 3.
 May 30 to June 9 inclusive, from Res. No. 2.
 June 10 to June 19 inclusive, from Res. Nos. 2 and 3.
 June 19 to June 24 inclusive, from Res. No. 2.
 June 25 to June 27 inclusive, from Res. Nos. 2 and 3.
 June 27 to June 30 inclusive, from Res. No. 2.
 June 30 to July 10 inclusive, from Res. Nos. 2 and 3.
 July 14 to July 17 inclusive, from Res. Nos. 2 and 3.
 July 18 to July 19 inclusive, from Res. No. 2.
 July 22 to July 24 inclusive, from Res. Nos. 2 and 3.
 July 28 to July 31 inclusive, from Res. Nos. 2 and 3.
 August 1, from Res. No. 2.
 August 5 to August 7 inclusive, from Res. Nos. 2 and 3.
 August 8, from Res. No. 2.

August 12 to August 14 inclusive, from Res. Nos. 2 and 3.

August 15, from Res. No. 2.

August 19 to August 21 inclusive, from Res. Nos. 2 and 3.

August 24 to September 8 inclusive, from Res. No. 2.

September 9 to September 11 inclusive, from Res. Nos. 2 and 3.

September 14 to October 3 inclusive, from Res. Nos. 2 and 3.

October 4 to November 14 inclusive, from Res. No. 2.

November 15 and 16, from Res. No. 1.

November 17 to November 22 inclusive, from Res. Nos. 1 and 2.

November 23 to December 5 inclusive, from Res. No. 2.

December 5 to December 12 inclusive, from Res. Nos. 2 and 3.

December 13 to January 1, 1888, inclusive, from Res. No. 2.

The conduit across Farm pond was used from June 2 to August 24; during the remainder of the year the supply was taken directly from Farm pond.

AQUEDUCTS AND DISTRIBUTING RESERVOIRS.

The Sudbury-river aqueduct has been in use 342 days and the Cochituate aqueduct 359½ days. The former has delivered into Chestnut-Hill reservoir 6,124,100,000 gallons, equal to a daily average supply of 16,778,400 gallons, while 4,802,120,700 gallons, equal to 13,156,500 gallons per day, have been drawn from Lake Cochituate. Both aqueducts have been cleaned once during the year; the details of this work will be found in the report of the Superintendent of the Western Division. The depths of water run in the Cochituate aqueduct have been as follows:—

January 1 to 7 inclusive, 6.50 feet.

January 8 to February 15 inclusive, 550 feet.

February 15 to 17 inclusive, 6 feet.

February 18 to June 27 inclusive, 5.50 feet.

June 28 to July 6 inclusive, 6 feet.

July 7 to August 26 inclusive, 6.50 feet.

From August 26 to January 1, 1888, the depth of water in the aqueduct has been governed by the level of the water in the lake, the depth being only about 4 feet during November. The Chestnut Hill, Brookline, Parker Hill, and

East Boston reservoirs are in good condition. The average monthly and yearly heights of all the reservoirs is shown by the table on page 46.

HIGH-SERVICE PUMPING-STATIONS.

The daily average amount of water pumped at the Highland station has been 3,441,000 gallons, an increase of 17.9 per cent. from that of the year 1886. The Worthington engine has been run 7,935 hours 45 minutes, an average of 21 hours 45 minutes per day, and has pumped 1,241,782,500 gallons, an average of about 3,400,000 per day.

One of the Boston Machine Co. engines was used for 197 hours, and pumped 14,198,700 gallons.

Total coal consumed, 2,541,900 lbs., of which 15.5 per cent. were ashes and clinkers.

Average lift, 115.88 feet.

Quantity pumped per pound of coal, 494.1 gallons.

Average duty (no deductions), 47,752,800 ft.-lbs. per 100 lbs.

Cost of Pumping.

Salaries	\$4,593 72
Fuel	7,217 53
Repairing	44 00
Oil waste, and packing	124 24
Small supplies	174 11
Total	\$12,153 60

Cost per million gallons lifted one foot high, 8.351 cents.

At the East Boston station the daily average amount pumped has been 329,500 gallons; at the West Roxbury station 34,100 gallons, and at the Brighton station about 200,000 gallons.

NEW HIGH-SERVICE WORKS.

These works are approaching completion, and within a few weeks the pumping-stations at Roxbury and Brighton will be abandoned, and the new works placed in service. Plans for the pumping-station at Chestnut Hill were prepared during the latter part of 1886, and, in order that work upon the masonry might be begun as soon as the season would permit, the excavations were begun on January 10, and continued until March 31, under the direction of Mr.

Fitzgerald, Superintendent of the Western Division. Plans and specifications were prepared for the foundations for the building and engines, together with the chimney, pump-wells, screen and connection chambers, and on March 2 a contract was executed with Collins & Ham for doing the work. They began active operations on April 1, and completed their contract on September 9. A contract for the masonry of the superstructure was awarded to Donahue Bros. on April 5, and on June 27 they commenced work on the erection of the building.

The walls of the building are now nearly completed, and the contractors for the iron roofs are erecting the trusses for the coal-shed and boiler-house. On May 6 a contract was made with George Miles, for furnishing and setting two boilers, and they are now set, and covered by a temporary wooden building. The first shipment of the Gaskill engines arrived on August 16, and the work of setting up the machinery has been in progress during the past four months. One engine is now ready to be started, and the second engine will be completed in a few weeks. The engines have been covered by a temporary wooden building to facilitate erection, and in order that they may be used before the completion of the permanent building.

The laying of the force main and the connections with the pumps have been completed by the Superintendent of the Eastern Division.

During the winter of 1886-87 Fisher-Hill reservoir, though uncompleted, was partially filled with water for the purpose of protecting the completed work from the frost. On April 8 the waste-gate was opened, and on April 21 the reservoir was empty.

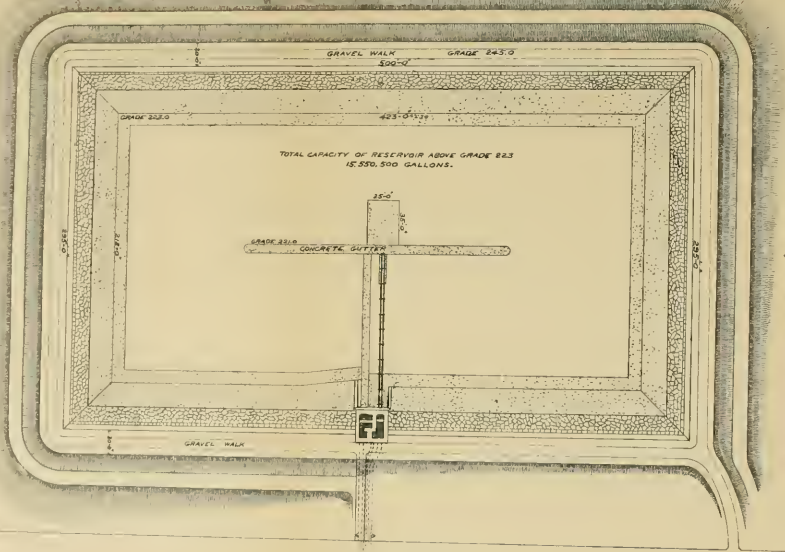
Work was resumed by the contractors, Moulton and O'Mahoney, on April 27, and was continued by them through the season, until November 18, when their contract was completed.

On November 30 the sluice-gates at the gate-chamber were finished, and the water was let into the basin, reaching high-water mark on Jan. 2, 1888. The following description and plates show the construction of this reservoir:—

The reservoir is rectangular in shape, 500 feet by 295 feet, measured at the top of the inner slope of the embankment, and 423 by 218 feet at the bottom of the slope. The high-water mark is 241 feet above tide-marsh level; the top of the earth embankment 245 feet; the foot of the inner slope 223 feet; the centre of the reservoir 221 feet, and the invert of the 36-inch pipe 220 feet. The reservoir is built partly in excavation and partly in embankment. The embankment

FISHER HILL RESERVOIR

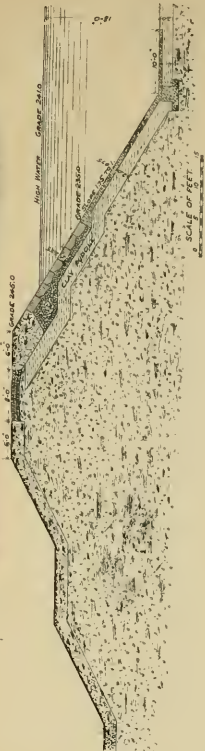
PLAN.



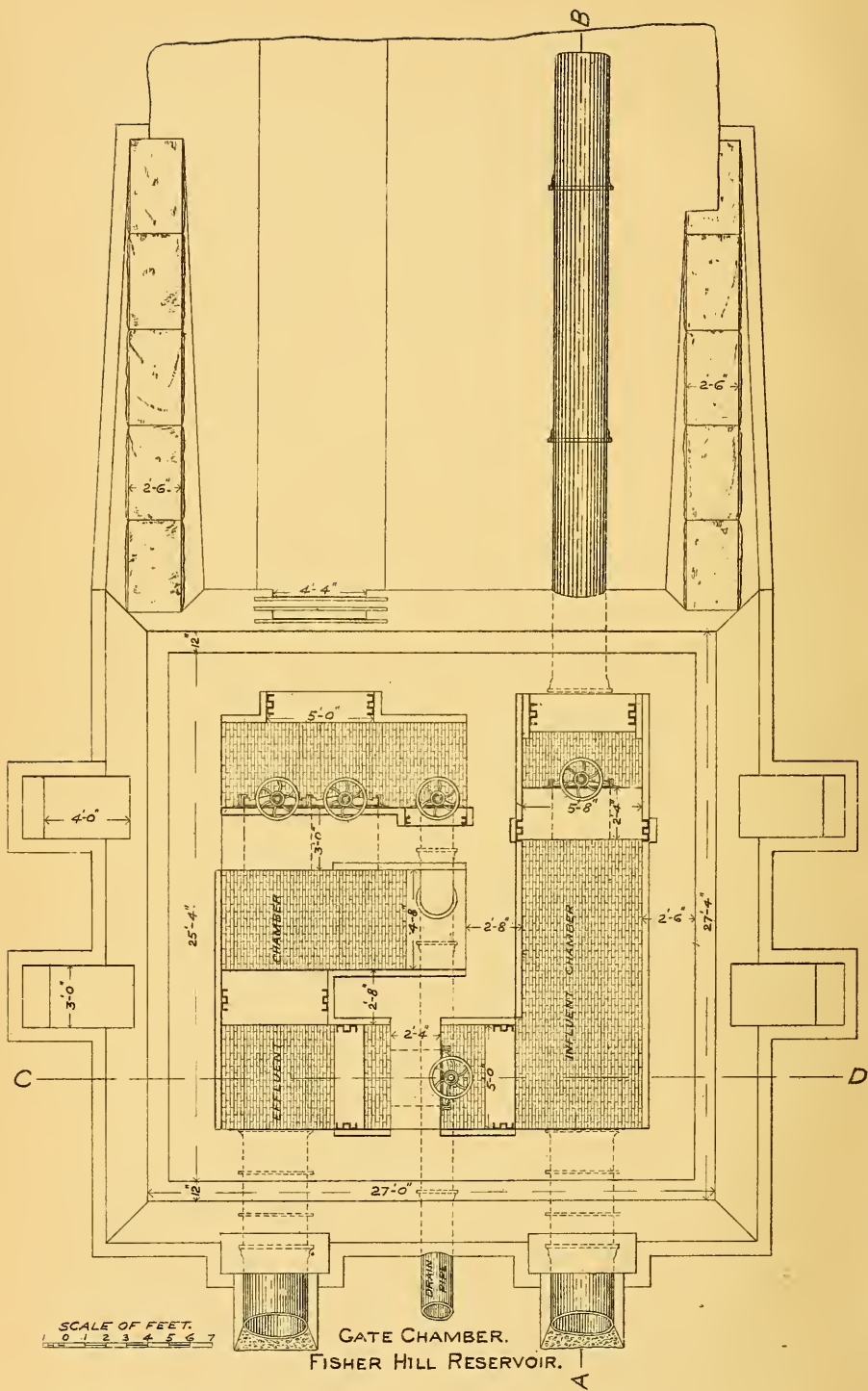
FISHER

AVENUE

SCALE OF FEET.
10 0 10 20 30 40 50 60 70

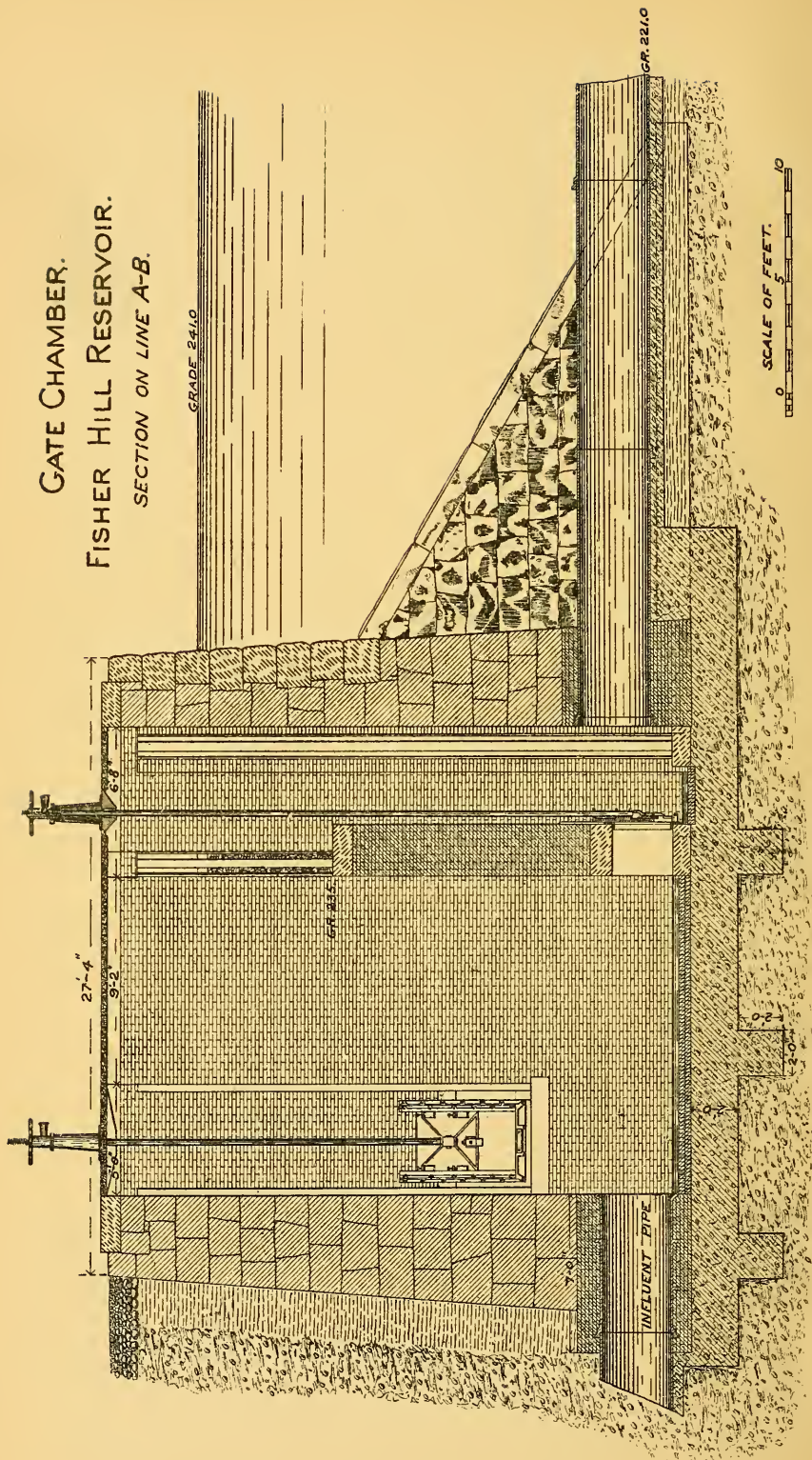


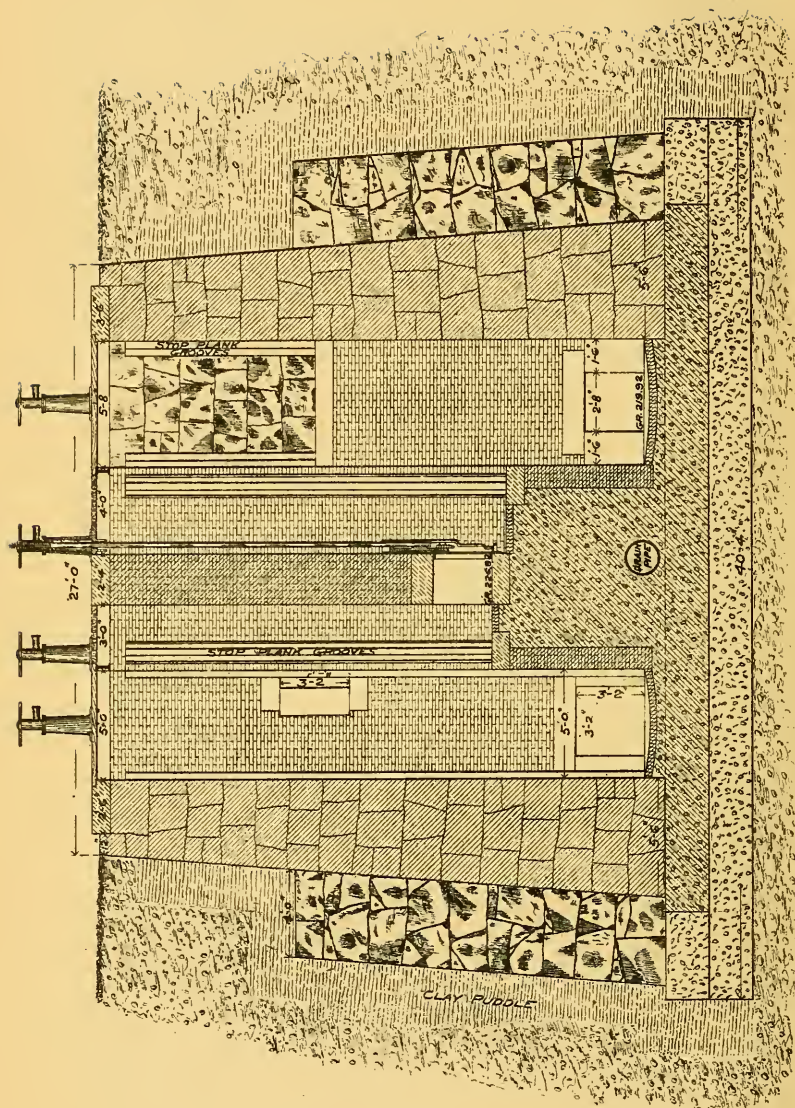
SECTION OF EMBANKMENT.



GATE CHAMBER.
FISHER HILL RESERVOIR.

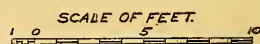
GATE CHAMBER. FISHER HILL RESERVOIR. SECTION ON LINE A-B.





GATE CHAMBER.
FISHER HILL RESERVOIR.

SECTION ON LINE C-D.



is 20 feet wide on top, with outside slopes of two horizontal to one vertical, and inside slopes of $1\frac{3}{4}$ horizontal to 1 vertical. It is composed of the material from the excavation, a compact, clayey gravel spread in 4-inch layers, watered and thoroughly rolled. The inner slope of the embankment is covered to above the high-water line with a layer of puddle 2 feet in thickness, composed of the natural material, from which all the large stones were removed, and brick clay, thoroughly mixed in the proportion of $\frac{2}{3}$ natural material and $\frac{1}{3}$ clay, wet and rammed in place. This puddle is covered from the base of the slope to grade 235 with a layer of Portland cement concrete 9 inches in thickness. Between grade 235 and 243 the slope is covered with a paving of Roxbury stone 15 inches in thickness underlaid by 12 inches of small broken stone.

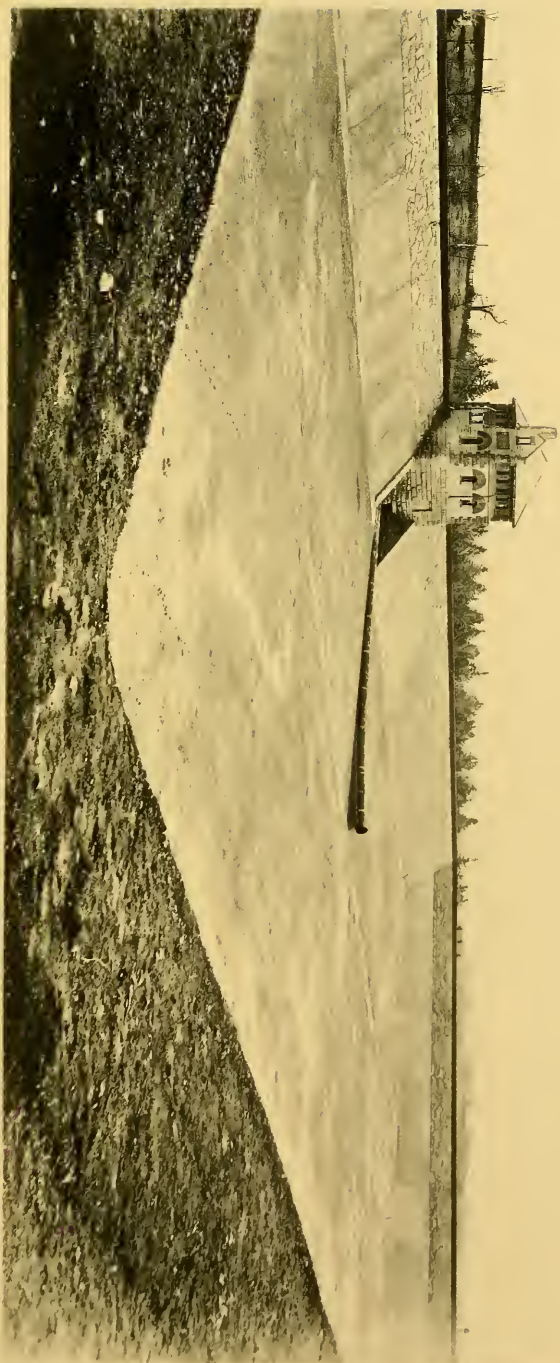
To prevent any slipping of the puddle or of the paving on the slope, an abutment of American cement concrete is placed at the foot of the slope, as shown on section. The bottom of the reservoir is covered with 2 feet of puddle, composed of the natural material mixed in thin layers with a small quantity of clay, wet and rolled. For a distance of 10 feet from the foot of the slope the bottom is covered with a layer of Portland cement concrete 6 inches in thickness. The bottom slopes toward the centre, and is drained by a concrete gutter to the gate-chamber. The outer slope of the embankment is covered with loam 2 feet in thickness, there being a surplus of loam from the excavation. A gravel walk 8 feet in width surrounds the reservoir on the top of the embankment. The gate-chamber is located in the centre of the easterly embankment. It is 20 feet by 20 feet 10 inches, inside dimensions, with side-walls of rubble granite masonry 26 feet high, 5 feet 6 inches thick at the bottom, and 3 feet 6 inches at the top, and is divided by brick partition walls into influent and effluent chambers, as shown on the accompanying plate. The foundation course is a bed of American cement concrete 2 feet thick, and below this there are three cut-off walls of concrete 2 feet square, running parallel with the centre line of the embankment, designed to cut off leakage. The water enters the gate-chamber through a 36-inch pipe, passes out through a 36-inch pipe, and enters the reservoir near the centre. A brick division wall, with sluice-gate at the bottom and stop-planks above, prevents the reservoir from being emptied in case of a break in the force-main. By means of two sluice-gates in the effluent chamber, water can be taken from different depths. The pipe for overflow and drainage is 16 inches in diameter; it is reduced to 12 inches outside of the reservoir, and carried down Fisher ave-

nue to Boylston street, there connecting with a surface drain. The drain from the reservoir of the town of Brookline is also connected with this pipe. The superstructure of the gate-house is brick with trimmings of Longmeadow brown stone. The work is now complete with the exception of some grading and sowing of the grounds, which will be done in the spring.

The total cost of this reservoir to date is as follows : —

Land	\$92,042 00
Construction of reservoir : —	
81,095 cubic yards earth excavation, \$33,248 95	
97 " " rock " 121 25	
2,476 " " clay delivered . 6,315 80	
5,566 " " slope puddle . 3,005 64	
6,429 " " bottom " . 3,085 92	
2,155 " " ballast in place . 5,387 50	
561 " " American cement concrete . 3,096 72	
1,350 " " Portland cement concrete . 10,287 00	
139 " " brick masonry . 1,390 00	
394 " " rubble " . 3,546 00	
1,104 " " slope paving . 3,941 28	
21.2 " " dimension masonry, 6-cut . 805 60	
37.7 " " dimension masonry, quarry face . 848 25	
139 lineal feet 36-inch pipe laid, 37 53	
42 " " 16-inch " " 6 30	
141 cubic yards granite slope paving . 554 13	
Extra labor and materials . . 289 40	
Total paid Moulton & O'Mahoney . . . 75,967 27	
Sluice-gates, etc. 1,215 00	
Gate-house superstructure 8,912 00	
Miscellaneous ; including engineering, advertising, office, etc. 9,948 35	
Total cost of reservoir	<u>\$188,084 62</u>

The total amount expended from the appropriation for new high-service on January 1, 1888, was \$464,981.86, of which \$31,330.82 was expended for the West Roxbury high-service.



HELIOTYPE PRINTING CO.,

BOSTON, MASS.

FISHER HILL RESERVOIR.

Plans and estimates have been made for high-service works to supply the high land of Breed's island, the construction of which was authorized by the City Council. A wrought-iron tank will be erected on the summit of Breed's Hill, to which water will be forced by pumps located at the present pumping-station near the reservoir.

The work can be commenced as soon as the weather will permit.

MYSTIC LAKE.

The surface of the lake was 5.52 feet above tide-marsh level on January 1, 1887, and water was wasting over the outlet dam. Waste was continued until June 12. The lake surface remained near high-water mark until September, and water was wasted over the dam during the greater portion of the month of August. On October 1 the lake was 1.79 feet below high water. During October and November the lake surface slowly rose, and on December 15 waste was commenced at the outlet dam.

MYSTIC-VALLEY SEWER.

The treatment of the sewage has been continued as in past years. Experiments have been in progress during the past year for the purpose of finding a more satisfactory method of treating the sewage than that now used. The results of these experiments have been encouraging, and I recommend their continuance on a more extended scale.

In this connection I may add that the present wooden tanks are so old and decayed that new ones are necessary; the engine is in need of renewal, and the reconstruction of these old works can be, at comparatively small expense, so adapted as to be used either with the present method of treatment or in connection with a more satisfactory one, should the experiments prove successful.

MYSTIC CONDUIT AND RESERVOIR.

The conduit was cleaned on June 8, and again on September 30. The reservoir is in good condition.

MYSTIC PUMPING-STATION.

The table on page 49 shows the work done by the engines at this station during each month of the past year.

Engine No. 1	was in use	109	hours	20	minutes	pumping	18,633,400	gallons.
" " 2	" " 1,531	" 50	"	"	"	" 278,851,700	"	
" " 3	" " 8,615	" 30	"	"	"	" 2,487,168,000	"	
Total amount pumped							2,784,653,100	"

Total amount of coal consumed 6,007,900 lbs.

Percentage of ashes and clinkers, 8.9.

Average lift, 147.73 feet.

Quantity pumped per pound of coal, 463.5 gallons.

Average duty of engines, no deductions, 57,106,200 feet lbs. per 100 lbs. of coal.

Daily average amount pumped 7,629,200 gallons, an increase of 3.1 per cent from that of the year 1886.

Cost of Pumping.

Salaries	\$8,283 05
Fuel	11,122 91
Repairs	625 69
Oil, waste, and packing	1,555 49
Small supplies	174 58
Total	\$21,761 72

Cost per million gallons raised one foot high, 5.29 cents.

The trusses supporting the roof of the engine-house were old, badly distorted, and in an unsafe condition; they are now being replaced by new ones of a new design. The roof of the coal bunker has rotted away, and I recommend that it be replaced by a shed roof during the present year.

CONSUMPTION.

The daily average consumption has been as follows: —

	Gallons per day.	Gallons per capita.
Sudbury and Cochituate supply	29,852,100	80.7
Mystic supply	7,629,000	72.7

The above figures show an increase in the consumption of the Sudbury and Cochituate works of 12.1 per cent. over that of the year 1886, of the Mystic works of 3.1 per cent, and of the combined supplies of 10.1 per cent. The increase on the Sudbury and Cochituate works has been larger than the probable increase in population. Although the number of premises supplied through meters has been reduced, there has been a large increase in the amount of metered water used, amounting to an increased daily consumption of 856,500 gallons of metered water, — about 13 per cent. over that of the year 1886, the metered water used in 1887 being at the rate of 7,229,700 gallons daily. Should allowance be made for the fewer premises metered, the percentage of

increase would be higher. The fact that the number of new service-pipes laid during the year has been larger than for any year since 1871 furnishes another reason for a large legitimate increase in consumption.

DETECTION OF WASTE.

The operation of the Deacon waste detection system and the work of setting stopcocks on the old service-pipes has been continued under the personal charge of Assistant Dexter Brackett, who reports as follows: —

CITY ENGINEER'S OFFICE,
BOSTON, January 11, 1887.

WILLIAM JACKSON, Esq., *City Engineer*: —

DEAR SIR, — The detection of waste by the Deacon meters and sidewalk stopcocks was begun on April 13, and continued until November 26. There are now connected with the works 75 Deacon meters, through which are supplied about 353,500 people, divided into 153 sections. During the season 728 diagrams were taken, showing the hourly rate of consumption and waste in these sections. In connection with the operation of the meters, night examinations have been made of all services which have been provided with shut-off cocks in the sidewalk, and all indications of waste reported to the Waste Detection Department with the following results: —

	Number of services tested.	Reported def. once.	Reported def. twice.
South Boston	6,925	1,005	97
North and West Ends . .	4,950	464	. .
South End Church cocks .	6,406	1,460	173
Charlestown	. . .	358	. .
Total	. . .	3,287	270

By examination by the Inspection and Waste Department the causes of waste were found to be as follows: —

	Services, burst inside.	Services, burst outside.	Ball-cocks.	Water-closets.	Sink faucets.	Bowl faucets.	Bath-tub faucets.	Stopcocks.	Urinals.	Hydrants.	Tank valves.	Motors.	Meters.	Sickness.	Wifal.
Church	79	26	641	416	342	17	11	3	5	2	9	5	47	11	442
West and North Ends	34	10	118	116	148	2	.	5	2	2	4	1	3	2	186
South Boston	115	26	266	336	277	2	3	12	.	8	.	.	7	4	358
Charlestown	35	5	39	95	42	.	.	1	.	.	.	.	.	1	58

The work of placing sidewalk stopcocks on the old service-pipes was begun for the season on April 18, and continued with a force of about 50 men until November 12. During that time 6,035 cocks were set, and 128 of the Church stopcocks were replaced by the ordinary pattern. This department has also established 19 new service-pipes, and replaced 284 cast-iron service-pipes with lead.

These iron services had been in use since the introduction of water, and were badly tuberculated. In many cases the passage for water had been reduced from the original diameter of $1\frac{1}{2}$ inches to $\frac{1}{8}$ inch or $\frac{1}{4}$ inch. The cost of these stopcocks set in position, including cost of service-box, labor, etc., has been about \$5 each.

DEXTER BRACKETT,

Assistant Engineer.

DISTRIBUTION.

During the year 1887 the following changes have been made in the distribution systems:—

SUDBURY AND COCHITUATE WORKS.			MYSTIC WORKS.	
Size of Pipe.	Total Length laid and relaid.	Length of Pipe abandoned.	Length laid.	Length abandoned.
4	973	3,848	3,451	7,570
6	47,926	5,611	24,293	2,172
8	21,779	.	500	.
10	5,771	.	4,690	90
12	42,718	.	.	.
16	1,093	.	660	.
20	.	1,256	.	.
24	5,929	.	.	.
30	2,562	.	.	.
36	52	.	.	.
48	1,528	1,528	.	.
	130,331	12,243	33,594	9,832

The total length of pipe laid on the Sudbury and Cochituate works was 24.68 miles; of this amount 2.32 miles were laid to replace existing pipes which were relaid for various reasons, making a net increase in the total length in use of 22.36 miles. This is the largest amount of pipe laid on the Sudbury and Cochituate works since 1875. On the Mystic works the mains have been extended 23,762 feet, and 9,928 feet of wrought-iron and cement pipe have been replaced by cast-iron pipes. The Cochituate distribution has been also greatly improved by removing the tubereles from the old 6-inch and 12-inch mains, by means of the Sweeney pipe-scraper. In the City proper, South and East Boston, there were cleaned during the year 40,932 feet of 6-inch and 20,280 feet of 12-inch pipe, at an average cost of 13.7 cents per foot for the 6-inch, and of 20 cents per foot for the 12-inch.

An order of the City Council, approved May 28, 1887, authorized the laying of a new main for the improvement of the East Boston supply, and a contract was made on June 11, with R. D. Wood & Co., for 1,100 tons of 24-inch pipe at \$35, and 170 tons of 30-inch pipe at \$34.50, per gross ton. In July the City Council authorized the laying of pipes for the supply of Charlestown from the Cochituate works. As the new main to East Boston was to be laid through Charlestown, the original plan for the East Boston main was modified by enlarging the size of the new main between the City proper and Charlestown, and connecting it with the large mains on the Common instead of with the 24-inch at Haymarket square. On September 21 a contract for 1,280 tons of 16-inch and 30-inch pipe, at \$30.69, was made with the Gloucester Iron Works. The contract of R. D. Wood & Co. has been completed, and 5,356 feet of 24-inch and 1,256 feet of 30-inch main laid in Charlestown and on Chelsea bridge. In connection with this work the bridge which carries the water pipe across the Mystic river has been rebuilt. This bridge was built in 1850, and the boxing rebuilt in 1867, when the Mystic works were extended to Chelsea. The boxing and fender-guard were very badly decayed. The contract for doing this work was made with J. N. Hayes & Co., on August 29, for the sum of \$14,500. The old piles were cut down and spliced in a substantial manner, with 10 by 12 inch hard-pine sticks. Three 10 by 14 inch longitudinal stringers, supported by 6 by 12 inch double girder caps are bolted to the tops of the spliced piles; a flooring of 4-inch spruce plank is laid upon the stringers, making a platform $8\frac{1}{2}$ feet in width, on which are laid the 16-inch and 30-inch pipes. The pipes are

covered by a housing large enough to be entered for examining and repairing the pipes. The new fender is placed 16 feet from the bridge, so as to provide a protection against injury from vessels.

The relocation and change of grade of Beacon street, in the town of Brookline, has necessitated the relaying of 1,528 feet of the 48-inch main, and there are other portions of the main which will require lowering during the coming season. A large amount of work has been done in connection with the petitions for main pipe, of which there were 249 during the season. Plans have been made, and lines and grades given, for all pipes laid during the year, and all gates and hydrants have been located and plotted upon the location plans filed in this office.

MISCELLANEOUS.

The sea-wall at the Albany-street pipe-yard has been rebuilt by Boynton Brothers, at a cost of about \$10,500. The old wall was taken down, additional piles driven, and the wall rebuilt, using new stone for the face, and also for a substantial cut-stone capping. On the face of the wall is an oak-pile fender with hard-pine cap. Examinations and estimates have been made of the cost of supplying the public institutions on Long Island with Cochituate water.

The following is a report from Mr. Desmond Fitzgerald, resident engineer, of the work intrusted to his charge:—

BOSTON, Jan. 1, 1888.

WILLIAM JACKSON, Esq.,

Chief Engineer Boston Water-Works:—

SIR.—The following brief report is submitted of engineering work on additional supply and the improvement of the old sources. During the winter of 1886–7 surveys and plans were made for the deepening of five sections of shallow flowage at Lake Cochituate, in the vicinity of the Beaver-dam and Course-brook valleys. This work was begun under your direction in September, and prosecuted to completion on December 20.

About 50,000 cubic yards of material have been moved. Plans have also been made for the further application of the same treatment to the Pegan meadows. Surveys and plans have been made in connection with studies already made for the construction of an additional basin in the Indian-brook valley of the Sudbury-river supply. A number of lines have been run, and estimates made for the relocation of the highways, and borings for foundations are now in progress.

Detail plans are making for a new dam at the outlet of Lake Cochituate, and other engineering studies in connection with the disposal of the sewage of the towns of Framingham and Marlboro' have been made by the engineering force.

Very truly yours,

DESMOND FITZGERALD,
Resident Engineer.

IN GENERAL.

The new dam at the outlet of Lake Cochituate should be built during the coming season when the conditions will be favorable for doing the work, as the water will be kept down in order to facilitate the deepening of some portions of the lake. Detail plans for this dam are now being prepared. It is especially important that advantage should be taken of the present opportunity to do this work, as the increasing consumption will make demands upon the sources of supply in the near future which will require all the available storage capacity to be utilized, and it would not then be safe to draw down the waters of the lake at a proper season of the year for constructing the dam. The new basin on Indian brook, for which a greater part of the land has been purchased, will require several seasons for its construction; it is therefore important that work should be commenced this year. Plans and investigations are now in progress, for the purpose of determining the final location of the dam, the most economical method of treating the shallower margins, and for the relocation of streets in Hopkinton and Ashland crossing the proposed location of the basin. The water from the Mystic supply is constantly deteriorating, although constant efforts have been made to protect its sources from pollution. The character of the water-shed is unfavorable for the collection of pure water, as its already large population is constantly growing, and without a system of sewers this must necessarily tend to continually increase the causes which render water unfit for domestic use.

The pipe-yard on Albany street is not large enough, and could the vacant wharf owned by the city, and adjoining this yard, be obtained, it would furnish additional space for storing pipes, which is much needed. The sea-wall on front of this wharf should be rebuilt; this will cost about \$6,000, and if the Water Department should assume this expense it would be a fair consideration for its use.

In some sections of the city supplied from old tuberculated pipes the character of the plumbing in the houses is such

that it is not practicable to clean the pipes with the machine which has been so successfully used elsewhere, and these pipes should be relaid, especially as in some cases larger ones are needed. The stand-pipe at Roxbury is now of no value to the water service of the city ; it has outlived its usefulness, and I recommend that the Board consider what disposition should be made of it.

As soon as the new high-service works are placed in operation, it is the intention to increase the territory now supplied by the high-service. This will necessitate considerable work, changing connections and laying new mains. Plans for the work are now being studied, and work can be commenced early in the season.

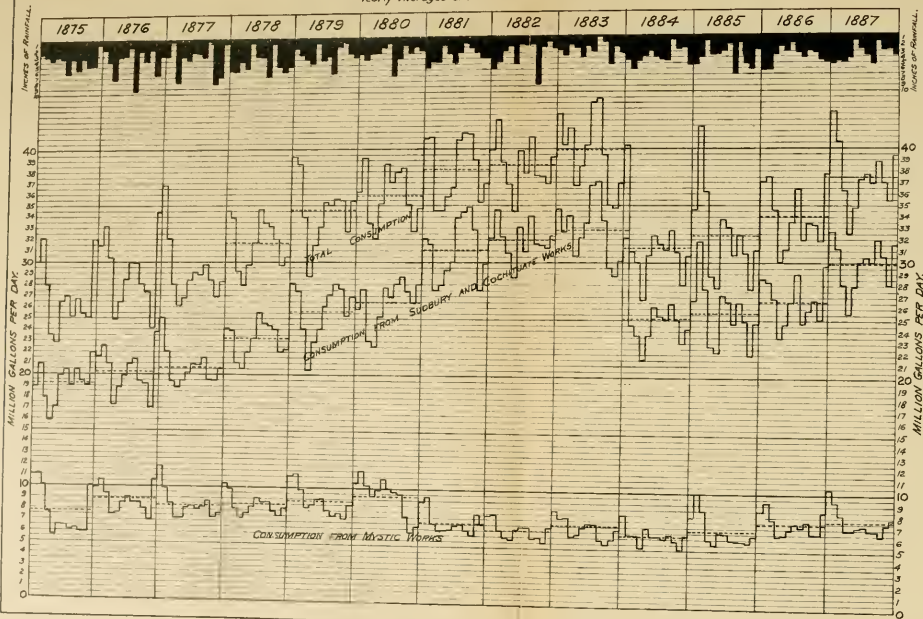
Appended to this report will be found the usual tables of rainfall, consumption, yield of water-shed, etc.

WILLIAM JACKSON,
City Engineer and Engineer B. W. Board.

BOSTON WATER WORKS.

Diagram showing the rainfall and daily average Consumption for each month.

Yearly Averages shown thus -----



Daily Average Consumption of Water, in Gallons, from the Cochituate and Mystic Works.

MYSTIC WORKS.													
	1881.	1882.	1883.	1884.	1885.	1886.	1887.						
January	32,121,900	7,816,200	8,369,600	8,019,100	7,855,400	8,510,300	10,488,600						
February	31,607,900	7,937,300	7,714,700	6,349,500	10,019,500	9,275,700	9,346,700						
March	27,531,700	6,573,700	7,737,300	6,337,100	8,487,500	7,780,000	8,175,000						
April	28,146,200	5,946,100	6,171,100	5,242,100	6,042,600	6,636,500	6,933,800						
May	29,307,600	5,793,600	6,319,100	5,800,000	5,605,700	6,444,000	6,916,300						
June	30,059,200	6,556,700	6,912,500	6,245,000	6,594,200	6,941,100	7,159,800						
July	33,835,300	6,906,400	7,307,600	6,312,300	6,513,300	7,437,500	7,250,000						
August	34,472,200	7,011,700	7,261,500	6,088,400	6,047,600	7,166,800	6,871,900						
September . . .	34,801,500	6,587,100	5,846,300	6,411,150	5,931,900	7,555,200	6,868,600						
October	32,871,200	6,011,300	5,497,200	5,834,200	5,914,900	6,552,000	6,436,600						
November . . .	27,519,800	7,870,400	5,930,600	5,119,700	5,710,300	6,546,000	7,361,200						
December	29,860,400	6,877,600	6,771,500	6,330,800	6,356,700	8,043,500	7,835,300						
Yearly average .	31,020,200	6,574,400	6,819,200	6,209,700	6,737,350	7,399,800	7,629,000						

COCHITUATE WORKS.							
Months.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
January	32,121,900	32,151,100	34,715,500	32,102,300	26,711,900	28,561,900	32,087,600
February	31,607,900	34,662,300	32,600,700	24,598,000	31,847,400	28,291,100	31,224,300
March	27,531,700	32,236,300	34,110,700	23,711,900	27,697,200	26,886,800	28,124,100
April	28,146,200	30,827,000	30,617,600	21,505,700	22,720,450	23,470,400	25,591,500
May	29,307,600	28,738,000	32,169,500	23,708,500	22,168,400	24,680,100	27,923,000
June	30,059,200	33,178,400	33,419,200	23,184,600	27,214,800	26,574,900	30,069,000
July	33,835,300	30,992,600	36,774,000	25,409,000	26,603,200	28,987,500	30,469,700
August	34,472,200	34,149,300	37,141,000	25,065,200	24,686,400	24,770,600	30,063,100
September . . .	34,801,500	31,697,600	33,645,000	26,389,500	26,493,600	25,835,600	31,946,600
October	32,871,200	31,563,800	29,575,800	25,022,900	24,945,500	26,713,100	30,562,700
November . . .	27,519,800	31,318,700	28,839,300	22,954,200	21,942,750	25,036,200	28,062,000
December	29,860,400	32,352,800	30,174,200	24,234,800	24,724,900	29,706,800	31,511,500
Yearly average .	31,020,200	31,970,800	32,830,900	25,090,500	25,607,200	26,627,900	29,852,100

Diversion of Sudbury-river Water, 1880-87.

MONTH.	1880.		1881.		1882.		1883.		1884.		1885.	1886.	1887.
	To Lake Cochituate.	To Chestnut-Hill Res'r.	To Lake Cochituate.	To Chestnut-Hill Res'r.	To Chestnut-Hill Res'r.	To Lake Cochituate.	To Chestnut-Hill Res'r.	To Lake Cochituate.	To Chestnut-Hill Res'r.	To Chestnut-Hill Res'r.	To Chestnut-Hill Res'r.	To Chestnut-Hill Res'r.	To Chestnut-Hill Res'r.
	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>
January . . .	228,400,000	673,600,000		814,800,000	595,000,000		733,400,000		697,000,000	473,900,000	502,200,000	602,200,000	
February . . .	11,300,000	604,100,000		680,300,000	975,700,000		597,800,000	1,004,300,000	265,400,000	560,400,000	380,800,000	472,000,000	
March	8,200,000	208,400,000		853,600,000	1,002,300,000	17,200,000	634,700,000		312,500,000	495,900,000	467,400,000	456,700,000	
April	161,300,000	348,000,000		810,700,000	781,200,000	967,900,000	555,700,000		228,800,000	350,400,000	307,000,000	385,400,000	
May	280,800,000	460,000,000		960,100,000	502,300,000	260,000,000	613,800,000		268,400,000	308,500,000	344,700,000	444,200,000	
June	136,700,000	308,600,000		941,700,000	491,800,000		631,600,000	168,400,000	414,500,000	768,000,000	427,100,000	463,600,000	
July		378,400,000		911,200,000	646,900,000		754,300,000	152,000,000	430,100,000	434,000,000	534,500,000	387,500,000	
August		592,000,000		730,700,000	655,800,000		640,900,000	1,600,000	406,100,000	401,100,000	463,100,000	352,800,000	
September . .		445,500,000		731,500,000	308,900,000		467,100,000		442,200,000	386,100,000	414,700,000	577,300,000	
October		434,600,000		429,300,000	570,200,000		483,300,000		432,900,000	368,300,000	474,100,000	672,300,000	
November . . .		398,200,000		321,700,000	572,300,000		580,800,000		363,900,000	297,600,000	381,800,000	607,100,000	
December . . .		402,100,000		472,100,000	632,200,000		536,800,000		432,500,000	379,900,000	570,200,000	703,000,000	
Totals	826,700,000	5,403,500,000	187,600,000	8,657,700,000	7,735,200,000	1,243,100,000	7,209,900,000	1,416,300,000	4,694,300,000	5,224,700,000	5,267,600,000	6,124,100,000	
To'tl div'rsion from Sud- bury river	6,230,200,000		8,845,300,000		7,735,200,000	8,453,000,000		6,110,600,000		5,224,700,000	5,267,600,000	6,124,100,000	
Average daily diversion for whole year	17,022,400		24,233,700		21,192,300	23,164,400		16,695,600		14,314,200	14,431,800	16,778,400	

Statement showing Amount of Water diverted from Sudbury River to Lake Cochituate and Chestnut-Hill Reservoir; Amount wasted; Amount of Flow in River; Percentage of Rainfall collected, etc., 1875 to 1887.

(Water-shed from 1875 to 1878, inclusive, = 77,764 sq. miles; in 1879 and 1880 = 78,228 sq. miles; and from 1881 to 1887, inclusive, = 75.2 sq. miles.)

YEAR.	Amount of Water diverted to Lake Cochituate and Chestnut-Hill Reservoir.	Amount of Water used by Frammingham Water Co.	Amount of Water wasted from River.	STORAGE.		Total amount of flow in River.	Daily average amount of flow in River.	Rainfall.	Rainfall collected.	Percentage of Rainfall collected.
				Gain.	Loss.					
	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.	Gallons.	Inches.	Inches.	Per cent.
1875	2,555,800,000		24,971,600,000	66,300,000		27,563,700,000	75,593,200	45.490	20.418	44.88
1876	2,528,300,000		29,942,300,000		160,700,000	32,309,900,000	88,278,400	49.563	23.908	48.24
1877	1,894,350,000		32,438,300,000	112,100,000		34,444,750,000	94,366,200	44.018	25.487	57.90
1878	3,422,100,000		37,125,200,000	654,700,000		41,202,000,000	112,882,200	57.631	30.487	52.63
1879	3,749,200,000		20,817,500,000	982,200,000		25,528,900,000	69,942,200	41.419	18.775	45.33
1880	6,230,200,000		11,200,000,000		958,600,000	16,561,600,000	42,250,300	38.177	12.182	31.91
1881	8,845,300,000		17,279,000,000	751,700,000		26,876,000,000	73,633,900	44.169	20.565	46.56
1882	7,735,200,000		16,273,900,000		352,600,000	23,556,500,000	64,812,300	39.394	18.102	45.45
1883	8,455,000,000		7,251,900,000		1,086,400,000	14,620,500,000	40,056,200	32.780	11.188	34.13
1884	6,110,600,000		23,228,900,000	1,744,600,000		31,084,100,000	84,929,200	47.135	23.784	50.46
1885	5,224,700,000	61,800,000	19,878,800,000		446,900,000	24,718,400,000	67,721,600	43.545	18.016	43.44
1886	5,267,600,000	76,600,000	23,023,000,000	1,461,500,000		29,831,700,000	81,730,700	46.065	22.825	49.55
1887	6,124,100,000	87,500,000	25,334,500,000	117,400,000		31,663,500,000	86,749,300	42.705	24.227	56.73
Averages . .	5,241,726, 00	75,300,000	22,219,607,700			27,699,350,000	75,611,900	44.030	20.836	46.75

Statement showing Amount of Water drawn from Lake Cochituate; Amount wasted; Amount of Rainfall collected in Lake; Amount received into Lake from Sudbury River; Percentage of Rainfall collected, etc., 1852 to 1887; Water-shed of Lake, 12,077 acres.

YEAR.	Amount of Water drawn from Lake.	Amount of Water wasted from Lake.	Amount received into Lake from Sudbury River.	STORAGE.		Total amount of Rainfall collected in Lake.	Daily average amount of Rain- fall collected in Lake.	Rainfall. Inches.	Rainfall collected. Inches.	Percentage of Rainfall collected.
				Gain.	Loss.					
1852	2,971,042,800	4,020,566,900	.....	.....	261,360,000	6,733,249,700	18,396,900	47.43	20.61	43.
1853	3,117,939,500	3,166,417,500	.....	239,580,000	.....	6,523,937,000	17,873,800	55.73	19.51	35.
1854	3,614,230,000	4,187,733,000	.....	.....	217,800,000	7,584,163,000	20,778,500	43.15	22.87	53.
1855	3,776,399,500	No account kept	.....	.....	326,700,000	.....	.....	34.96	.....	.....
1856	4,409,787,600	"	.....	598,950,000	.....	.....	.....	40.80	.....	.....
1857	4,644,990,000	10,625,900,000	.....	32,670,000	.....	15,303,560,000	41,927,600	63.10	46.69	74.
1858	4,689,155,000	1,934,500,000	.....	.....	141,570,000	6,482,085,000	17,759,000	48.66	19.46	40.
1859	4,808,875,000	7,569,000,000	.....	283,140,000	.....	12,661,015,000	34,687,700	49.02	38.24	78.
1860	6,309,108,000	None.	.....	174,240,000	.....	6,483,348,000	17,714,100	55.44	19.40	35.
1861	6,639,095,900	3,377,559,000	.....	.....	1,459,260,000	8,557,394,900	23,444,900	45.44	25.45	56.
1862	6,059,000,000	33,290,000	.....	1,306,800,000	.....	7,399,000,000	20,271,200	49.69	22.36	45.
1863	5,927,052,500	2,165,696,500	.....	762,300,000	.....	8,855,049,000	24,260,400	69.30	26.88	39.
1864	6,105,306,700	1,368,746,000	.....	.....	1,848,577,000	5,625,475,700	15,370,200	42.60	18.55	43.
1865	4,621,630,000	1,688,120,700	.....	743,242,500	.....	7,052,993,200	19,323,300	49.46	20.50	41.
1866	4,463,585,000	None.	.....	743,242,500	.....	5,206,827,500	14,265,300	62.32	16.01	26.
1867	4,951,225,000	2,482,044,000	.....	.....	698,811,000	6,734,455,000	18,450,600	56.25	21.80	39.

1868	5,405,515,000	2,507,684,000		346,371,000		8,259,570,000	22,567,200	49.71	24.98	50.
1869	5,503,751,000	1,635,570,000		480,882,000		7,620,203,000	20,877,300	64.34	21.99	34.
1870	5,477,810,000	4,818,971,000			1,736,085,000	8,560,696,000	23,453,900	55.89	26.08	47.
1871	5,225,500,000	None.			250,933,000	4,972,567,000	13,623,500	45.39	15.16	33.
1872	5,775,151,200	None.				5,612,480,300	15,416,600	48.47	17.22	35.
1873	6,511,826,900	2,917,977,000			515,132,000	8,914,671,900	24,423,800	45.43	27.13	60.
1874	6,623,972,900	1,145,851,700			1,307,715,000	6,402,109,600	17,540,000	35.93	19.52	54.
1875	7,092,955,500	None.		2,555,800,000		5,760,040,500	15,780,900	45.49	17.57	39.
1876	7,277,175,200	1,619,243,800		2,528,300,000		6,411,557,000	17,517,900	48.49	19.54	40.
1877	7,626,880,200	1,484,978,600		1,894,350,000		7,506,244,800	20,811,600	43.80	23.17	53.
1878	7,743,904,700	3,341,875,000		2,698,300,000		8,637,268,700	23,663,700	53.58	26.34	49.
1879	6,051,838,900	1,523,361,400		411,300,000		5,841,203,000	16,003,300	38.01	17.81	47.
1880	4,284,147,100	65,577,700		826,700,000		3,376,759,800	9,226,100	35.83	10.30	29.
1881	2,816,459,700	2,231,016,700		187,600,000		5,337,965,800	14,679,400	41.09	16.34	40.
1882	3,935,490,600	1,358,543,700				4,936,699,600	13,525,200	40.29	15.05	37.
1883	4,731,227,700	162,361,800		1,245,100,000		3,314,089,500	9,079,700	31.20	10.11	32.
1884	4,533,156,450	1,842,837,100		1,416,300,000		6,300,130,250	17,213,450	45.57	19.21	42.
1885	4,091,674,900	1,006,622,800				5,106,892,500	13,991,500	43.66	15.57	36.
1886	4,432,536,100	3,116,283,200				7,188,157,300	19,693,600	46.97	21.92	47.
1887	4,802,120,700	3,658,662,900				7,697,568,600	21,089,200	41.58	23.47	56.
Averages	5,199,736,800	2,266,379,100				7,032,336,100	19,255,900	47.63	21.37	44.

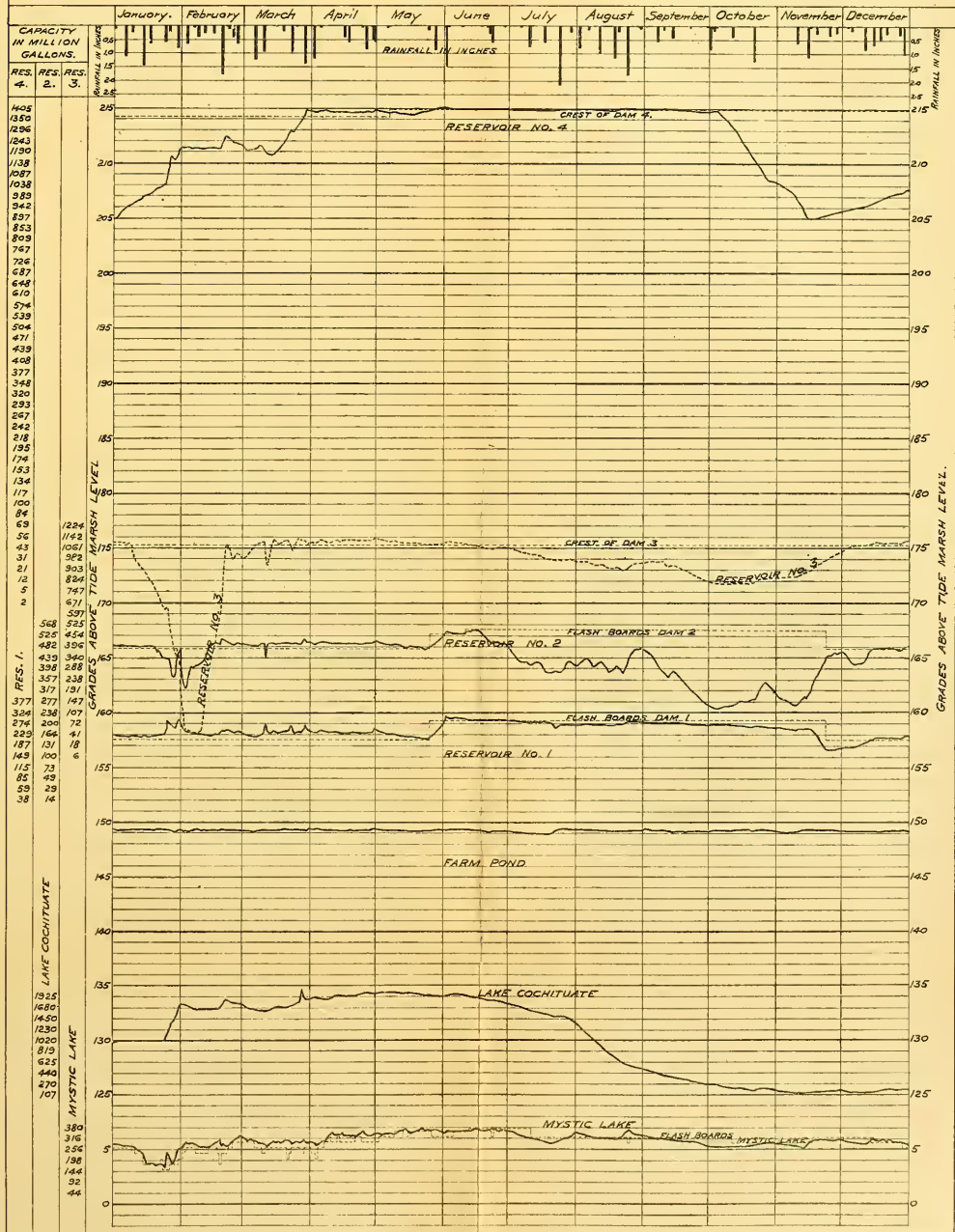
¹ Observation of Rainfall at Lake Cochituate commenced 1852, and these observations are assumed as correct for the whole district.

² Lake raised two feet.

Table showing the average Monthly and Yearly Heights above tide-marsh level of the Water in the Lakes and Reservoirs of the Boston Water-Works.

MONTHS.	Reservoir No. 1. Flash boards 159.25.		Reservoir No. 2. Flash boards 167.12.		Reservoir No. 3. Stone crest 175.24.		Reservoir No. 4. Stone crest 214.21.		Farm Pond. High water 149.25.		Lake Coquette. High water 134.36.		Chestnut-Hill Reservoir. High water 124.00.		Brookline Reservoir. High water 124.00.		Parker Hill Reservoir. High water 219.00.		Mystic Lake. High water 7.00.		Mystic Reservoir. High water 141.00.	
	1886.	1887.	1886.	1887.	1886.	1887.	1886.	1887.	1886.	1887.	1886.	1887.	1886.	1887.	1886.	1887.	1886.	1887.	1886.	1887.	1886.	1887.
January . .	157.96	158.15	166.09	165.54	158.24	171.68	197.41	207.56	149.22	149.22	132.07	130.43	123.75	123.47	123.49	123.15	217.90	217.31	6.03	4.58	146.89	146.90
February .	158.46	158.20	166.43	165.34	161.34	165.94	206.73	211.53	149.55	149.23	133.63	133.17	123.57	123.48	123.33	123.18	217.46	217.86	5.98	5.54	146.86	146.90
March . . .	157.42	158.22	166.24	166.25	157.70	175.15	211.06	212.09	149.08	149.24	133.40	133.15	123.59	123.72	123.37	123.46	217.54	218.00	5.94	5.71	146.85	146.85
April . . .	155.54	158.23	166.33	166.31	155.73	175.65	214.65	214.06	145.60	149.27	134.29	134.07	123.80	123.57	123.63	123.33	218.17	218.05	6.13	6.18	146.67	146.78
May	155.09	158.01	167.24	166.18	155.16	175.50	214.53	214.69	145.01	149.25	134.22	134.23	123.66	123.70	123.46	123.45	218.30	217.87	6.46	6.66	146.73	146.72
June . . .	155.16	159.37	167.02	166.99	154.96	175.19	214.55	214.98	145.00	149.24	133.35	133.86	123.72	123.71	123.07	123.44	218.18	217.88	6.20	6.74	146.74	146.67
July	154.49	159.03	161.33	164.43	154.68	174.26	214.56	214.87	145.06	149.13	131.97	132.59	123.72	123.35	123.47	122.73	218.03	218.14	5.04	6.11	146.80	146.75
August . .	154.48	158.98	156.72	164.59	154.54	173.42	211.97	214.91	145.21	149.25	130.85	128.96	123.85	123.02	123.45	120.39	217.88	218.33	3.34	6.31	146.79	146.69
September	154.41	159.02	156.84	163.18	151.46	173.11	203.61	214.86	145.21	149.23	129.51	126.63	123.64	123.50	123.31	123.01	217.92	217.72	0.94	5.90	146.80	146.67
October . .	154.63	158.80	156.31	161.25	156.09	171.95	201.32	211.67	145.29	149.30	128.15	125.69	123.60	123.80	123.35	123.27	218.13	217.90	-0.92	5.40	146.65	146.74
November .	154.63	157.87	162.21	162.84	163.14	173.22	198.61	203.10	146.61	149.26	127.63	125.27	123.65	123.86	123.40	123.53	217.75	218.17	0.96	5.65	146.71	146.78
December .	157.70	157.47	165.72	165.48	170.41	175.35	201.75	206.07	149.22	149.29	128.28	125.39	123.71	123.83	122.96	123.55	218.32	216.49	4.17	5.74	146.85	146.81
Yearly averages }	155.83	158.45	163.21	164.86	158.04	173.37	207.81	212.05	146.65	149.24	131.45	130.29	123.69	123.58	123.36	123.04	217.96	217.81	4.19	5.88	146.78	146.77

Diagram showing the heights of Sudbury River Reservoirs, Farm Pond, and Cochituate and Mystic Lakes, and the Rainfall on the Sudbury River Water Shed during the year 1887.



Statement showing Amount of Water drawn from Mystic Lake; Amount wasted; Amount of Rainfall collected in Lake; Percentage of Rainfall collected, etc., 1887; Water-shed of Lake, 17,200 Acres.

YEAR.	Amount of Water drawn from Lake.	Amount of Water wasted from Lake.	STORAGE.		Total amount of Rainfall collected in Lake.	Daily average amount of Rainfall col- lected in Lake.	Rainfall.	Rainfall collected.	Percentage of Rainfall collected.
			Gain.	Loss.					
	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Per cent.</i>
1876	3,238,101,380	6,369,774,700		32,583,000	9,567,293,000	26,140,100	47.00	20.49	43.6
1877	3,069,554,800	7,250,223,500		16,291,400	10,393,486,900	28,228,700	43.095	22.06	51.2
1878	3,367,490,400	8,718,547,600		26,000,000	12,060,038,000	33,041,200	54.065	25.82	47.8
1879	3,490,848,200	4,625,691,800		203,000,000	7,913,540,000	21,680,900	35.30	16.94	48.0
1880	3,692,195,700	2,158,761,200		113,500,000	5,763,756,900	15,584,000	34.42	12.21	35.5
1881	2,815,579,900	5,534,300,000	371,200,000		8,721,079,900	23,893,400	41.91	18.67	44.5
1882	2,576,896,700	4,444,668,000	15,000,000		7,030,564,700	19,261,800	39.165	15.05	38.4
1883	2,664,514,200	2,084,702,600		347,579,000	4,351,637,800	11,922,300	31.22	9.32	29.84
1884	2,469,761,000	6,574,003,800	380,600,000		9,424,364,800	25,719,600	44.39	20.18	45.46
1885	2,639,278,800	5,588,860,500		33,200,000	8,194,939,300	22,451,900	44.50	17.55	39.43
1886	2,862,947,500	7,743,258,900		28,400,000	10,577,806,400	28,980,300	45.56	22.65	49.71
1887	2,954,257,500	7,414,213,000		11,000,000	10,357,470,500	28,376,600	46.42	22.17	47.77
Averages	2,985,618,800	5,704,750,500			8,683,831,500	23,775,900	42.254	18.59	43.43

Statement of Operations at the Highland Pumping-Station for the Year 1887.

1887.	WORTHINGTON ENGINE.			ENGINE No. 2.			Total amount pumped.	Gallons.	Daily average.	Gallons.	Lbs.	Total amount of coal consumed.	Daily average amount of coal consumed.	Total amount ashes and clinkers.	Per cent. ashes and clinkers.	Quantity pumped per lb. of coal.	Average lift in feet.	Duty in ft.-lbs. per 100 lbs. of total coal.
	Total pump- ing time.		Amount pumped.	Total pump- ing time.		Amount pumped.												
	Hrs.	Min.		Hrs.	Min.													
	Hrs.	Min.	Gallons.	Hrs.	Min.	Gallons.												
January	686	. . .	115,196,000	. . .	. . .	115,196,000	3,716,000	8,000	36,175	14.6	464.5	118.27	45,817,800					
February	588	. . .	94,906,500	. . .	. . .	94,906,500	3,339,500	7,125	30,290	15.2	475.7	115.73	45,916,500					
March	651	. . .	100,114,500	. . .	. . .	100,114,500	3,229,500	6,658	33,455	16.2	485.1	113.42	45,882,500					
April	630	15	92,101,000	. . .	. . .	92,101,000	3,070,000	6,023	28,785	15.9	509.7	111.80	47,525,800					
May	678	15	105,105,500	. . .	. . .	105,105,500	3,390,500	6,616	32,050	15.6	512.5	112.73	48,179,000					
June	684	. . .	107,167,000	. . .	. . .	107,167,000	3,572,200	7,113	33,700	15.8	502.2	113.19	47,406,800					
July	711	30	114,607,000	20	30	1,452,300	116,059,300	3,743,800	7,555	38,245	16.3	495.6	115.04	47,544,500				
August	653	45	98,208,000	. . .	. . .	. . .	98,208,000	3,168,000	6,332	32,600	16.6	500.3	114.11	47,613,700				
September	633	. . .	98,223,500	. . .	. . .	. . .	98,223,500	3,274,100	6,367	30,195	15.8	514.3	112.27	48,150,000				
October	651	. . .	101,571,500	. . .	. . .	. . .	101,571,500	3,276,500	6,242	28,715	14.8	524.9	112.04	49,046,800				
November	630	. . .	96,115,500	. . .	. . .	. . .	96,115,500	3,203,800	6,080	27,190	14.9	526.9	114.11	50,150,300				
December	739	. . .	118,466,500	176	30	12,746,400	131,212,900	4,232,700	9,400	42,315	14.5	450.3	137.91	51,789,200				
Totals and Averages	7,935	45	1,241,782,500	197	. . .	14,198,700	1,255,981,200	3,441,000	6,964	393,715	15.5	494.1	115.88	47,752,800				

Statement of Operations at the Mystic Pumping-station for 1887.

1887.	ENGINE No. 1.			ENGINE No. 2.			ENGINE No. 3.			Total amount pumped.	Gallons.	Daily average amount pumped.	Lbs.	Daily average amount of coal consumed.	Lbs.	Daily average amount ashes and clinkers.	Per cent.	Gal.	Average lift in feet.	Duty in foot-lbs. of total coal.								
	Total pumping time.		Amount pumped.	Total pumping time.		Amount pumped.	Total pumping time.		Amount pumped.												Gallons.	Gallons.	Lbs.	Lbs.	Per cent.	Gal.	Feet.	Ft.-lbs.
	Hrs.	Min.		Hrs.	Min.		Hrs.	Min.																				
January	53	45	8,637,200	509	35	90,856,700	737	. .	225,740,800	325,234,700	10,491,400	23,758	1,995	8.4	441.6	148.47	54,680,000											
February . . .	2	15	392,000	332	45	60,022,500	671	15	200,960,000	261,375,100	9,334,800	20,500	1,769	8.6	455.4	148.14	56,238,800											
March	12	30	1,993,200	133	45	23,993,900	742	30	227,684,000	253,571,100	8,179,700	17,242	1,430	8.3	474.4	147.82	58,485,900											
April	36	35	6,749,700	30	15	6,326,900	672	30	195,097,600	208,174,200	6,939,100	14,683	1,251	8.5	472.6	147.58	58,166,700											
May	. . .	. . .		24	30	4,635,700	738	45	209,536,000	214,171,700	6,908,800	14,161	1,163	8.2	487.9	147.57	60,042,900											
June	. . .	. . .		79	30	15,084,900	705	. . .	200,012,800	215,097,700	7,160,900	15,283	1,288	8.4	469.1	147.81	57,831,800											
July	. . .	. . .		71	45	13,967,500	728	45	210,739,200	224,706,700	7,248,600	15,855	1,458	9.2	457.2	147.89	56,389,400											
August	4	15	860,700	12	45	2,672,700	726	. .	209,177,600	212,711,000	6,861,600	14,900	1,430	9.6	460.5	147.45	56,630,800											
September . . .	. . .	. . .		21	15	4,016,600	703	30	201,446,400	205,493,000	6,848,800	14,850	1,381	9.3	461.2	147.52	56,741,800											
October	. . .	. . .		11	. . .	2,234,800	737	. . .	198,067,200	200,302,000	6,461,400	13,887	1,308	9.4	465.3	147.56	57,239,400											
November . . .	. . .	. . .		120	15	21,668,500	712	15	199,065,600	229,734,100	7,337,800	15,617	1,531	9.8	471.2	147.55	57,978,300											
December . . .	. . .	. . .		184	30	33,371,000	741	. . .	209,740,800	243,111,800	7,842,300	17,000	1,666	9.8	461.3	147.45	56,729,200											
Totals and averages	109	20	18,633,400	1,531	50	278,851,700	8,615	30	2,487,168,000	2,784,653,100	7,629,200	16,460	1,472	8.9	463.5	147.73	57,106,200											

Rainfall in inches and hundredths on the Sudbury River Water-shed for the Year 1887.

1887.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1.	0.055					0.025				0.785		
2.				1.20		1.60		0.82	0.015	0.09		
3.		0.675				0.035				0.185		0.015
4.										0.035		
5.				0.045						0.01		0.18
6.	1.125	0.035	1.24		0.08		0.055	0.16				
7.					0.02				0.575			
8.		0.42										
9.	0.24					0.01						
10.			0.985				0.77		0.145		0.655	
11.		0.285						1.00		0.415		0.84
12.												
13.												
14.	1.48								0.455			
15.		0.30	0.015								1.09	0.685
16.			0.01	0.425							0.045	
17.	0.65						0.61					
18.				0.595		0.015		1.17				0.485
19.		1.795	0.22								0.285	
20.								0.215				
21.		0.01				0.05				1.315		0.285
22.		0.11				0.295			0.085			
23.			0.975			0.62						
24.	0.59	0.465		0.055			2.115	1.775				
25.			0.02		0.18						0.335	
26.	0.225	0.685		0.87								
27.												0.325
28.				0.015	0.885						0.26	1.065
29.			1.435	0.49			0.21	0.02				
30.	0.835			0.57				0.12	0.045			
31.												
Totals .	5.20	4.78	4.90	4.265	1.165	2.65	3.76	5.28	1.32	2.835	2.67	3.88

Total rainfall during the year, 42.705 inches.

Being an average of two gauges located at Framingham and Westboro'.

Rainfall in inches and hundredths on Lake Cochituate Water-shed for 1887.

1887.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1						0.10				0.52		
2				1.19		1.14		0.85	0.01	0.11		
3		0.81								0.10		
4										0.02		
5				0.04								0.14
6	1.00	0.04	1.24		0.07		0.02	0.12				
7					0.09				0.57			
8		0.45										
9	0.20						0.06					
10			1.07				0.54		0.16		0.80	
11		0.34					0.53	0.39		0.52		0.91
12									0.35			
13												
14	1.45											
15		0.25	0.05								1.04	0.75
16			0.03	0.50			0.01				0.07	
17	0.81											
18				0.69			0.35	0.73				0.64
19		1.94	0.21									
20								0.12			0.29	
21							0.04			1.22		0.27
22		0.16					0.82		0.09			
23			1.08			1.34	1.13					
24	0.69	0.48		0.08			0.08	1.49				
25			0.02		0.15						0.28	
26	0.25	0.87		0.94	0.04							
27												0.28
28					0.67						0.28	0.81
29			1.40	0.56			0.19					
30	0.89			0.45					0.10			
31												
Totals	5.29	5.34	5.10	4.45	1.02	2.58	3.77	3.70	1.28	2.49	2.76	3.80

Total rainfall during the year, 41.58 inches.

*Rainfall in inches and hundredths on the Mystic Lake Water-shed for
1887.*

1887.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1.	. . .	. . .	. . .	. . .	. . .	. . .	0.01	. . .	. . .	0.905	. . .	. . .
2.	. . .	. . .	. . .	1.20	. . .	1.24	. . .	0.50	. . .	0.105	. . .	. . .
3.	. . .	0.62	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.125	. . .	0.02
4.	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
5.	. . .	. . .	. . .	0.045	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.14
6.	0.975	0.015	1.065	. . .	. . .	. . .	0.015	0.52	. . .	. . .	. . .	. . .
7.	. . .	. . .	. . .	. . .	0.09	. . .	. . .	. . .	0.85	. . .	. . .	. . .
8.	. . .	0.52	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
9.	0.195	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
10.	. . .	. . .	1.03	. . .	. . .	. . .	1.18	. . .	0.215	. . .	0.82	. . .
11.	. . .	0.305	. . .	0.015	. . .	. . .	0.585	0.30	. . .	0.78	. . .	0.765
12.	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.24	. . .	. . .	. . .
13.	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
14.	1.26	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
15.	. . .	0.13	0.01	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.72
16.	. . .	. . .	0.005	0.56	. . .	. . .	. . .	. . .	. . .	. . .	1.315	. . .
17.	0.70	. . .	. . .	. . .	. . .	. . .	0.04	. . .	. . .	. . .	. . .	. . .
18.	. . .	. . .	. . .	0.59	. . .	. . .	0.025	0.505	. . .	. . .	. . .	0.41
19.	. . .	1.645	0.34	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
20.	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.525	. . .	. . .	0.25	. . .
21.	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	1.125	. . .	0.38
22.	. . .	0.145	. . .	. . .	. . .	0.445	1.275	. . .	0.165	. . .	. . .	. . .
23.	. . .	. . .	1.025	. . .	. . .	1.01	0.905	. . .	. . .	. . .	. . .	. . .
24.	0.90	0.565	. . .	0.15	. . .	. . .	0.275	2.605	. . .	. . .	. . .	. . .
25.	. . .	. . .	0.015	. . .	0.165	. . .	. . .	. . .	. . .	. . .	0.40	. . .
26.	0.175	0.525	. . .	1.04	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
27.	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.01	. . .	. . .	. . .	0.37
28.	. . .	. . .	. . .	. . .	1.435	. . .	. . .	. . .	. . .	. . .	0.265	0.77
29.	. . .	. . .	1.51	. . .	. . .	. . .	2.275	. . .	. . .	. . .	. . .	. . .
30.	1.04	. . .	. . .	1.005	. . .	. . .	. . .	. . .	0.03	. . .	. . .	. . .
31.	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Totals .	5.245	4.47	5.00	4.605	1.69	2.695	6.585	4.965	1.50	3.04	3.05	3.575

Total rainfall during the year 46.42 inches.

Being an average of two gauges located at Mystic Lake and Mystic Station.

Monthly Rainfall, in inches, for 1887, at various places in Massachusetts.

PLACE.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Totals.
Lake Cochituate	5.29	5.34	5.10	4.45	1.02	2.58	3.77	3.70	1.28	2.49	2.76	3.80	41.58
Framingham	5.20	5.07	4.96	4.60	1.06	2.42	3.81	4.62	1.29	2.87	2.64	3.91	42.45
Westboro'	5.20	4.49	4.84	3.93	1.27	2.88	3.71	5.94	1.35	2.80	2.70	3.85	42.96
Chestnut Hill	5.57	4.44	5.20	4.74	1.69	2.08	3.69	3.53	1.35	3.21	2.75	3.66	41.91
Mystic Station	5.27	4.51	4.96	4.69	1.63	2.70	6.74	4.76	1.46	3.02	3.16	3.43	46.33
Mystic Lake	5.22	4.43	5.04	4.52	1.75	2.69	6.43	5.17	1.54	3.06	2.94	3.72	46.51
Mystic Engine-House	4.66	4.125	4.60	4.02	1.42	1.915	4.615	4.075	1.255	3.03	2.925	3.51	40.15
Boston Pipe-yard	5.93	4.37	5.27	4.35	1.69	2.15	3.92	3.21	1.24	2.84	2.59	3.59	41.15
Boston U.S. Signal-Service	4.86	3.69	3.86	2.62	1.67	1.98	3.59	3.05	0.97	2.53	2.22	2.71	33.75
Cambridge Observatory	7.09	4.96	5.66	5.46	1.69	1.90	4.16	3.73	1.11	3.36	2.87	3.71	45.70
Waltham (Boston Manufacturing Co.)	5.99	4.66	5.23	4.76	1.62	2.97	4.58	4.64	1.59	2.91	2.87	4.13	45.95
Lowell (Locks and Canals Co.)	5.72	5.182	4.738	4.046	1.644	2.608	5.425	10.931	2.228	3.116	3.27	4.547	53.455
Lowell (Merrimac Manufacturing Co.)	5.54	5.18	4.73	3.16	0.86	1.18	5.16	12.28	2.56	3.08	3.52	4.88	52.13
Averages	5.503	4.650	4.937	4.257	1.463	2.312	4.584	5.357	1.479	2.947	2.863	3.304	44.156

Rainfall received and collected, 1887.

MONTHS.	MYSTIC.			COCHITUATE.			SUDBURY.		
	Rainfall.	Rainfall collected.	Per cent. collected.	Rainfall.	Rainfall collected.	Per cent. collected.	Rainfall.	Rainfall collected.	Per cent. collected.
	Inches.	Inches.	Per cent.	Inches.	Inches.	Per cent.	Inches.	Inches.	Per cent.
January . .	5.245	3.16	60.23	5.29	4.06	76.81	5.20	4.619	88.82
February . .	4.47	3.61	80.81	5.34	4.34	81.27	4.78	4.558	95.35
March . . .	5.00	3.60	72.00	5.10	4.70	92.23	4.90	5.116	104.40
April . . .	4.605	3.75	81.34	4.45	3.36	75.48	4.265	4.522	106.03
May	1.69	1.89	112.03	1.02	1.35	132.35	1.165	1.799	154.46
June . . .	2.095	1.27	47.26	2.58	0.82	31.79	2.65	0.714	26.93
July	6.585	0.87	13.21	3.77	0.72	19.12	3.76	0.204	5.45
August . .	4.965	1.35	27.11	3.70	1.33	35.81	5.28	0.382	7.24
September .	1.50	0.48	32.01	1.28	0.64	50.04	1.32	0.191	14.52
October . .	3.04	0.57	18.67	2.49	0.49	19.80	2.835	0.339	11.96
November .	3.05	0.71	23.41	2.76	0.70	25.16	2.67	0.636	23.83
December .	3.575	0.91	25.63	3.80	0.96	25.33	3.88	1.147	29.58
Totals and averages }	46.42	22.17	47.77	41.58	23.47	56.45	42.705	24.227	56.73

Table showing the Temperature of Air and Water at different Stations on the Water-Works.

1887.	TEMPERATURE OF AIR.						TEMPERATURE OF WATER.	
	Chestnut-Hill Reservoir.			Framingham.			Brookline Reservoir.	Mystic Engine-house.
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Mean.	Mean.
January	54.0	-14.5	23.1	56.0	-24.0	21.8	36.7	34.0
February	46.5	1.0	27.6	48.0	-1.0	27.7	36.4	33.5
March	49.5	5.0	30.2	50.0	7.0	30.6	37.0	34.1
April	76.0	22.0	43.1	79.0	20.0	44.0	43.5	41.1
May	88.0	35.5	59.4	90.0	34.0	61.3	53.8	60.5
June	92.0	41.5	65.1	94.0	41.0	66.2	66.0	67.5
July	95.5	57.0	74.6	97.0	57.0	76.2	74.5	75.8
August	86.5	47.0	66.5	88.0	45.0	67.0	73.6	73.8
September	80.0	32.5	58.3	80.0	29.0	58.0	66.1	65.9
October	72.0	24.0	49.5	77.0	19.0	50.0	55.3	56.1
November	67.0	16.0	40.5	68.0	14.0	39.6	43.1	44.2
December	57.5	-1.0	30.6	58.0	-3.0	29.6	37.2	36.2

Rainfall received and collected on the Sudbury-River Water-shed.

Area of water-shed, 1880, 78,238 square miles; area of water-shed, 1881-1887, 75.2 square miles.

MONTHS.	1880.			1881.			1882.			1883.			1884.			1885.			1886.		
	Rainfall.	Rainfall col- lected.	Per cent. col- lected.	Rainfall.	Rainfall col- lected.	Per cent. col- lected.	Rainfall.	Rainfall col- lected.	Per cent. col- lected.	Rainfall.	Rainfall col- lected.	Per cent. col- lected.	Rainfall.	Rainfall col- lected.	Per cent. col- lected.	Rainfall.	Rainfall col- lected.	Per cent. col- lected.	Rainfall.	Rainfall col- lected.	Per cent. col- lected.
	<i>Ins.</i>	<i>Ins.</i>		<i>Ins.</i>	<i>Ins.</i>		<i>Ins.</i>	<i>Ins.</i>		<i>Ins.</i>	<i>Ins.</i>		<i>Ins.</i>	<i>Ins.</i>		<i>Ins.</i>	<i>Ins.</i>		<i>Ins.</i>	<i>Ins.</i>	
January .	3.566	2.000	56.02	0.740	5.558	13.31	5.951	2.213	37.19	2.81	0.597	21.25	5.085	1.775	34.91	4.71	2.293	46.76	6.365	2.606	40.94
February .	3.980	2.982	74.92	4.046	2.491	53.62	4.546	3.872	85.18	3.865	1.664	43.05	6.545	4.742	72.45	3.865	2.182	56.44	6.28	7.784	123.16
March . .	3.315	2.451	73.93	7.142	5.730	124.64	2.649	5.064	191.16	1.78	2.873	161.42	4.72	6.752	143.06	1.07	2.805	292.14	3.61	3.672	161.72
April . . .	3.105	2.017	64.97	2.000	2.669	133.44	1.824	1.497	82.09	1.845	2.380	126.27	4.405	4.925	111.82	3.605	3.133	86.91	2.225	3.361	151.06
May . . .	1.836	0.917	49.95	3.511	5.066	45.48	4.185	2.304	45.48	4.185	1.073	39.96	3.47	1.838	52.97	3.485	2.383	68.38	2.995	1.285	42.90
June . . .	2.138	0.303	14.16	5.395	2.309	42.80	1.604	0.913	54.87	2.40	0.518	21.58	3.445	0.719	20.86	2.865	0.735	25.66	1.465	0.350	23.93
July . . .	6.273	0.315	5.02	2.550	0.493	20.98	1.769	0.154	8.70	2.68	0.206	7.68	3.665	0.399	10.89	1.425	0.111	7.77	3.265	0.206	6.32
August . .	4.008	0.212	5.29	1.358	0.264	19.45	1.667	0.099	5.91	0.735	0.140	19.06	4.65	0.458	9.85	7.185	0.429	5.97	4.10	0.168	4.09
September,	1.603	0.138	8.64	2.617	0.340	13.01	8.741	0.529	6.05	1.52	0.157	10.36	0.855	0.076	8.87	1.425	0.209	14.66	2.905	0.203	6.98
October . .	3.740	0.181	4.85	2.955	0.331	11.20	2.074	0.534	25.74	5.60	0.331	5.92	2.48	0.148	5.98	5.095	0.599	11.75	3.255	0.260	8.04
November,	1.785	0.354	19.85	4.091	0.682	16.66	1.147	0.362	31.51	1.81	0.354	19.52	2.645	0.302	11.44	6.095	2.033	33.35	4.645	1.161	25.01
December,	2.828	0.312	11.05	3.958	1.383	34.93	2.296	0.561	24.45	3.55	0.345	9.72	5.17	1.650	31.91	2.72	2.094	76.99	4.975	1.819	36.56
Totals and averages }	38.177	12.182	31.91	44.169	20.565	46.56	39.394	18.102	45.95	32.78	11.188	34.13	47.135	28.784	50.46	43.545	18.916	43.44	46.065	22.825	49.55

The rainfall for 1880, 1881, 1882 is an average of five gauges located at Framingham, Westboro', Southboro', Marlboro', and Hopkinton.
The rainfall for 1883, 1884, 1885, 1886, is an average of two gauges located at Framingham and Westboro'.

WATER REGISTRAR'S REPORT.

JANUARY 1, 1888.

OFFICE OF THE WATER REGISTRAR,

BOSTON, Jan. 2, 1888.

HORACE T. ROCKWELL, Esq., *Chairman Water Board*:—

SIR,—The annual report of the Water Registrar as required by Section 9, Chapter 30, of the Revised Ordinances is herewith submitted.

COCHITUATE WORKS.

The total receipts of the Cochituate Works for the year ending Dec. 31, 1887, have been \$1,275,298 32

The detail of this amount is as follows:—

Received from sale of water furnished in 1887	\$1,128,708 89
Received from sale of water furnished in 1886	115,482 86
Received from elevator, motor and fire pipes, ...	3,183 45
“ “ service-pipes and repairs	6,950 77
“ “ sale of merchandise	1,352 61
“ “ off and on water for repairs	2,394 25
“ “ fines	1,625 00
“ “ rent of water-posts	345 00
“ “ off and on water for non-payment	1,411 00
	<u>\$1,261,453 83</u>

Add sundry receipts by Water Board 13,844 49

Total \$1,275,298 32

MYSTIC WORKS.

The total receipts of the Mystic Works during the year 1887 have been \$295,196 99

The detail of this amount is as follows :—

Received from the sale of water in 1887,	\$273,754 32
“ “ “ “ “ “ “ “ 1886,	19,264 33
“ “ service and fire pipes . . .	456 08
“ “ off and on water for repairs . .	240 00
“ “ fines	178 50
“ “ off and on water for non- payment	164 00
“ “ maintenance (stand-pipes) . .	45 00
“ “ sale of old material	25 84
	\$294,128 07
Add sundry receipts by Water Board . .	1,068 92
	<u>\$295,196 99</u>

The percentage allowed the cities of Somerville, Chelsea, and town of Everett under contract, is as follows :—

Somerville	\$43,109 25
Chelsea	33,911 27
Everett	7,558 17
	<u>\$84,578 69</u>

The expenditures of this department for the year 1887 are as follows :—

	Mystic.	Cochituate.
For salaries	\$8,321 69	\$29,466 85
Labor	2,852 76	11,406 16
Printing and stationery	516 27	1,398 37
Travelling expenses	142 35	1,538 29
Postage, telephone, etc.	411 03	85 60
	<u>\$12,244 10</u>	<u>\$43,895 27</u>

The estimated income from all sources from the Mystic and Cochituate departments for the year 1888 is \$1,607,000 00

	Mystic.	Cochituate.
From water-rates	\$310,000 00	\$1,265,000 00
“ all other sources	2,000 00	30,000 00
Total	<u>\$312,000 00</u>	<u>\$1,295,000 00</u>

The total number of takers supplied by Cochituate Works is	58,983
The total number of takers supplied by Mystic Works is	19,893
The total number of meters now applied to premises of both Cochituate and Mystic Works is	3,534

The following table represents the size, kind, and location of each meter :—

Size and Kind of Meter.	Cochituate Works.	Charlestown.	Chelsea.	Somerville.	Everett.	Total.
$\frac{3}{4}$ inch Worthington	208	18	7	8	1	242
$\frac{1}{2}$ " "	403	24	20	9	1	457
1 " "	429	39	14	18	1	501
$1\frac{1}{2}$ " "	57	2	2	2	61	
2 " "	72	15	8	8	2	105
3 " "	13	1	1	1	15	
4 " "	7	4	2	2	13	
$\frac{3}{4}$ " Crown	1,061	78	13	12	1,164	
$\frac{1}{2}$ " "	116	32	6	5	159	
1 " "	155	12	4	5	1	177
$1\frac{1}{2}$ " "	27	1	1	1	29	
2 " "	27	6	2	2	35	
3 " "	20	4	1	1	26	
4 " "	11	4	1	1	16	
6 " "	1	2	1	1	3	
$\frac{1}{2}$ " Tremont	412	6	3	3	421	
1 " "	36	5	1	3	45	
$\frac{3}{4}$ " Desper	12	1	1	1	12	
$\frac{1}{2}$ " "	1	1	1	1	1	
1 " "	1	1	1	1	1	
$\frac{3}{4}$ " New England	1	1	1	1	1	
$\frac{3}{4}$ " Hersey	6	1	1	1	6	
$\frac{3}{4}$ " Ball & Fitz	11	1	1	1	11	
$\frac{1}{2}$ " "	9	1	1	1	10	
1 " "	6	1	1	1	6	
2 " "	2	1	1	2	2	
3 " "	3	1	1	1	2	
$\frac{3}{4}$ " Spooner	1	1	1	1	1	
1 " "	1	1	1	1	1	
$\frac{1}{2}$ " Fox	1	1	1	1	1	
$\frac{3}{4}$ " Frost	1	1	1	1	1	
1 " "	2	1	1	1	2	
$1\frac{1}{2}$ " "	1	1	1	1	1	
$\frac{3}{4}$ " Balance Valve	2	1	1	1	2	
$\frac{1}{2}$ " Star	5	1	1	1	6	
Total	3,114	253	81	79	7	3,534

COCHITUATE WORKS.

The following table exhibits the classes of premises to which meters are attached, the amount of water consumed, and the revenue assessed for the years 1886 and 1887:—

CLASS OF PREMISES	1886.		1887.	
	Quantity used. Cubic feet.	Amount assessed.	Quantity used. Cubic feet.	Amount assessed.
Hotels	23,980,000	\$29,843 90	30,439,000	\$37,637 63
Apartment Hotels	41,425,000	56,026 50	37,438,000	50,297 40
Business Premises	64,699,000	86,856 17	72,490,000	96,301 95
Steam Railroads	26,493,000	32,271 40	31,239,000	37,941 40
Sugar Refineries	29,973,000	36,083 00	35,479,000	42,691 10
Factories and Machinists	23,623,000	31,153 63	31,901,000	41,519 00
Iron Works and Foundries	5,963,000	7,428 10	6,581,000	8,176 40
Mills and Engines	3,093,000	4,143 70	2,012,000	2,699 50
Marble and Stone Works	2,263,000	2,922 35	2,679,000	3,426 10
Gas Companies	12,699,000	15,416 90	15,415,000	18,756 99
Breweries	10,403,000	12,896 20	14,344,000	17,636 20
Oil Works	1,709,000	2,158 30	1,089,000	1,393 10
Chemical Works	2,680,000	3,264 00	2,105,000	2,566 20
Laundries	437,000	577 80	640,000	840 20
Restaurants	4,763,000	6,436 40	7,103,000	9,608 40
Stables	11,237,000	15,330 00	13,282,000	17,922 20
Theatres and Halls	1,223,000	1,602 50	1,235,000	1,662 00
Hospitals	1,986,000	2,484 60	1,778,000	2,229 60
Schools	2,814,000	3,791 30	2,873,000	3,921 90
City, State, and Government Buildings .	9,548,000	11,956 10	10,491,000	13,107 20
Steamers and Shipping	7,846,000	9,986 60	8,004,000	10,256 82
Elevators and Motors	15,222,000	20,461 90	15,912,000	21,562 56
Electric Light Companies	4,280,000	5,248 20	5,242,000	6,405 20
Miscellaneous	1,776,000	2,367 30	2,074,000	2,776 10
Total	310,161,000	\$400,706 85	351,845,000	\$451,335 09

MYSTIC WORKS.

The following table exhibits the classes of premises to which meters are attached, the amount of water consumed, and the revenue assessed for the years 1886 and 1887 :—

CLASS OF PREMISES.	1886.		1887.	
	Quantity used. Cubic feet.	Amount assessed.	Quantity used. Cubic feet.	Amount assessed.
Steam Railroads	21,225,860	\$25,705 40	24,741,325	\$29,903 41
Horse Railroads	999,353	1,333 43	1,298,212	1,662 67
Hoosac Tunnel Dock and Elevator Co. .	1,333,037	1,623 64	1,132,000	1,382 40
City and Government Buildings	6,523,518	8,127 32	6,550,817	8,144 67
Schools	853,956	1,189 13	917,572	1,264 86
Stables	1,945,374	2,634 91	2,023,916	2,828 61
Factories	5,639,307	7,624 65	5,411,259	7,056 28
Chemical Works	1,033,113	1,409 98	1,168,000	1,428 80
Foundries	759,946	1,073 75	734,948	999 60
Breweries	816,000	1,041 30	909,642	1,146 19
Gas Companies	279,960	369 97	717,790	897 02
Oil Works	131,575	179 59	3,230	4 52
Mills and Engines	760,835	1,067 39	1,126,559	1,517 37
Hotels	481,989	657 20	600,520	823 85
Model Houses	1,910,633	2,611 47	1,721,500	2,394 05
McLean Insane Asylum	1,320,780	1,608 63	1,330,000	1,620 00
Slaughter-houses	2,433,370	2,975 30	3,814,783	4,642 54
Business Purposes	640,703	897 61	927,461	1,276 63
Wharves	429,792	586 76	691,581	925 38
Laundries	386,780	548 60	372,468	503 15
Elevators and Motors	99,144	139 30	63,571	89 00
Bakeries	454,705	621 64	485,000	652 00
Restaurants	145,000	203 90	189,169	264 54
Tanneries	988,458	1,265 68	1,003,513	1,275 93
Miscellaneous	2,791,000	3,833 93	2,810,457	3,538 35
Total	54,390,138	\$69,330 48	60,745,293	\$76,241 82

The quantity used through meters in the different districts was as follows :—

	1886.		1887.	
	Cubic feet.	Amount.	Cubic feet.	Amount.
Charlestown	38,896,106	\$48,532 81	42,333,136	\$52,836 16
Somerville	7,864,843	10,118 67	9,817,027	12,468 05
Chelsea	6,231,974	8,894 97	7,241,496	9,254 90
Everett	1,297,215	1,784 03	1,353,634	1,682 71
Total	54,390,138	\$69,330 48	60,745,293	\$76,241 82

The following table exhibits the yearly revenue from the sale of Cochituate water since its introduction into the city, October 25, 1848 :—

Received by Water Commissioners, as per

Auditor's report, in 1848	\$972 81
From January 1, 1849, to January 1, 1850	71,657 79
“ “ 1850, “ 1851	99,025 45
“ “ 1851, “ 1852	161,052 85
“ “ 1852, “ 1853	179,567 39
“ “ 1853, “ 1854	196,352 32
“ “ 1854, “ 1855	217,007 51
“ “ 1855, “ 1856	266,302 77
“ “ 1856, “ 1857	282,651 84
“ “ 1857, “ 1858	289,328 83
“ “ 1858, “ 1859	302,409 73
“ “ 1859, “ 1860	314,808 97
“ “ 1860, “ 1861	334,544 86
“ “ 1861, “ 1862	365,323 96
“ “ 1862, “ 1863	373,922 33
“ “ 1863, “ 1864	394,506 25
“ “ 1864, “ 1865	430,710 76
“ “ 1865, “ 1866	450,341 48
“ “ 1866, “ 1867	486,538 25
“ “ 1867, “ 1868	522,130 93
“ “ 1868, “ 1869	553,744 88
“ “ 1869, “ 1870	597,328 55
“ “ 1870, “ 1871	708,783 68
“ “ 1871, “ 1872	774,445 70
“ “ 1872, “ 1873	862,704 08

From January 1, 1873, to January 1, 1874 .	\$917,415	92
“ “ 1874, “ 1875 .	977,020	48
“ “ 1875, “ 1876 .	1,005,120	94
“ “ 1876, “ 1877 .	1,029,643	70
“ “ 1877, “ 1878 .	1,015,562	89
“ “ 1878, “ 1879 .	1,010,584	30
“ “ 1879, “ 1880 .	1,025,803	14
“ “ 1880, “ 1881 .	1,039,896	17
“ “ 1881, “ 1882 .	1,087,528	49
“ “ 1882, “ 1883 .	1,127,982	32
“ “ 1883, “ 1884 .	1,167,704	17
“ “ 1884, “ 1885 .	1,203,192	55
“ “ 1885, “ 1886 .	1,239,757	99
“ “ 1886, “ 1887 .	1,206,064	69
“ “ 1887, “ 1888 .	1,244,191	75

The following table exhibits the yearly revenue from the sale of Mystic water since its introduction, November 29, 1864 : —

From November 29, 1864, to January 1, 1866,	\$22,419	55
“ January 1, 1866, to January 1, 1867 .	46,447	69
“ “ 1867, “ 1868 .	56,532	04
“ “ 1868, “ 1869 .	89,758	21
“ “ 1869, “ 1870 .	105,948	98
“ “ 1870, “ 1871 .	176,769	57
“ “ 1871, “ 1872 .	203,824	88
“ “ 1872, “ 1873 .	237,926	25
“ “ 1873, “ 1874 .	257,983	15
“ “ 1874, “ 1875 .	269,868	22
“ “ 1875, “ 1876 .	310,672	92
“ “ 1876, “ 1877 .	291,992	98
“ “ 1877, “ 1878 .	286,590	18
“ “ 1878, “ 1879 .	283,439	89
“ “ 1879, “ 1880 .	270,599	82
“ “ 1880, “ 1881 .	273,735	24
“ “ 1881, “ 1882 .	230,856	78
“ “ 1882, “ 1883 .	251,928	53
“ “ 1883, “ 1884 .	260,011	91
“ “ 1884, “ 1885 .	265,921	04
“ “ 1885, “ 1886 .	276,557	60
“ “ 1886, “ 1887 .	249,609	62
“ “ 1887, “ 1888 .	293,018	65

The daily returns from the Service Division represent a total of 10,355 orders received during the year, as follows :—

Application for service-pipes	1,901
“ “ turning on water for first time	2,010
“ “ repairs in service-pipes	1,390
“ “ off and on water for repairs	3,473
“ “ “ “ “ non-payment	1,581
Total	<u>10,355</u>

DRINKING-FOUNTAINS.

The total number of drinking-fountains established to Jan. 1, 1888, is 68, all of which, with the exception of 12, have automatic fixtures to prevent the flow of water.

They are distributed as follows, viz. :—

Boston Proper	21
East Boston	4
South Boston	8
Roxbury	7
West Roxbury	5
Dorchester	6
Brighton	5
Charlestown	6
Chelsea	1
Somerville	4
Everett	1
	<u>68</u>

HYDRAULIC MOTORS.

The total number of hydraulic motors now located is 90, being an increase of 15 during the year 1887. They are applied to a variety of business premises, church organs, etc.

HYDRAULIC ELEVATORS.

The total number of hydraulic elevators established to date is 283, being an increase of 10 over the previous year. They are located principally in business premises and apartment-houses.

WATER-POSTS.

There are 124 water-posts now located for street-sprinkling purposes, being an increase of 14 during the past year.

They are located as follows :—

Boston Proper	.	.	.	.	.	5
South Boston	.	.	.	.	.	5
East Boston	.	.	.	.	.	1
Roxbury	.	.	.	.	.	14
Dorchester	.	.	.	.	.	17
West Roxbury	.	.	.	.	.	25
Brighton	.	.	.	.	.	16
Charlestown District	.	.	.	.	.	6
Chelsea	.	.	.	.	.	3
Somerville	.	.	.	.	.	26
Everett	.	.	.	.	.	6
						123

Table showing the Number and Kind of Water-fittings contained within the Premises of Water-takers to January 1, 1888.

	Taps.	Sinks.	Bosws.	WATER-CLOSETS.					Bath-tubs.	Wash-tubs.	Slop-hoppers.	Foot-tubs.	Urinals, Automatic.	Urinals, Plain.	Private Hydrants.
				Street Pressure.	Tank Pressure.	Hopper.	Waste.	Flush.							
Wards 1, 2, 6, 7	1,407	18,986	5,026	5,796	3,855	30	100	45	1,132	1,003	36	4	881	223	28
Wards 8, 9, 10, 11, 12	3,532	24,435	22,323	7,472	15,206	142	148	21	7,717	10,617	1,035	275	2,349	384	8
Wards 13, 14, 15, 16, 17 . . .	1,739	26,498	8,580	8,240	6,688	32	109	123	4,069	4,967	54	3	265	63	10
Wards 18, 19, 20, 21	2,842	20,217	14,455	7,224	9,615	7	31	67	7,048	10,617	129	37	181	34	. .
Wards 22, 23, 24, 25	3,537	16,015	6,482	3,074	7,501	9	137	1	4,789	6,201	74	7	70	32	2
Totals	13,057	106,151	56,866	31,806	42,865	220	525	257	24,755	33,405	1,328	326	3,746	736	48
Charlestown District	1,443	11,353	2,211	3,608	2,294	9	131	. . .	1,131	1,231	. . .	. . .	78	61	. . .
Chelsea	1,116	7,916	2,066	2,553	1,748	8	33	. . .	1,288	1,209	. . .	. . .	47	52	. . .
Somerville	2,198	9,178	2,745	2,771	2,926	18	55	. . .	2,217	1,922	. . .	. . .	36	31	. . .
Everett	437	1,687	346	122	346	1	7	. . .	329	184	. . .	. . .	1	3	. . .
Totals	5,194	30,134	7,368	9,054	7,314	36	226	. . .	4,965	4,546	. . .	. . .	162	147	. . .

Respectfully submitted,

WM. F. DAVIS, Water Registrar.

REPORT OF THE SUPERINTENDENT OF THE WESTERN DIVISION.

SOUTH FRAMINGHAM, Jan. 1, 1888.

COL. H. T. ROCKWELL, *Chairman Boston Water Board*:—

SIR, — The annual report for the Western Division of the Boston Water-Works is submitted herewith.

SUDBURY-RIVER BASINS.

Basins 1, 2, and 3 are full, and water wasting over the dams. Basin 4 is not yet full. The quality of the water has generally been excellent throughout the year. The supply, as usual, has been principally drawn from Basin 2. From October 4 to November 15 water was drawn from Basin No. 4. This basin was of better quality than last year, and after July was better than any of the other basins, attributable to its greater depth. In Basin No. 3 the water near the bottom was not very good during the summer which was probably owing to the large amount of work done there during the previous year.

Between October 5 and November 8 a considerable amount of *algæ* appeared in Basin 3, and no water was drawn from that source during this period; otherwise the water has been freer from vegetable growth than usual.

These are the principal facts in regard to the Sudbury supply. A more detailed account will be found under each basin.

BASIN 1.

On Jan. 1, 1887, the water in this basin stood at grade 157.98 above tide-marsh level in Boston, and water was wasting over the dam.

On May 25 both sets of flash-boards were put on the stone crest. On June 2 the water began to run over the top of the flash-boards, and continued to waste, with the exception of three days, until June 26.

On November 10 the basin stood at elevation 158.49.

Between November 16 and November 23 water was drawn into Farm Pond, and the level reduced to 156.63. The

water then gradually rose, and on December 11 began to waste over the stone crest, and so continued to the end of the year.

The lowest point reached during the year was on November 25, viz., 156.62, and the highest, 159.69, on June 2. The flow of one and one-half million gallons per day has been passed into the river every day, in accordance with the law. The usual amount of care has been given to the maintenance of the works around the basin. The 48-inch main in the bottom of this reservoir has not been repaired. It is in bad condition, but no favorable opportunity has offered for examining the joints.

BASIN 2.

On Jan. 1, 1887, this basin stood at grade 166.13, and water was wasting over the stone crest of the dam. This continued until May 25, when both sets of flash-boards were put in place. Water flowed over the top of these flash-boards from June 1 to June 10, when a temporary set of boards was added, raising the surface to 167.50. On June 16 waste stopped, and as the water was drawn for the supply of the city, the basin gradually lowered to elevation 163.64, on July 20. It then rose, and was kept for about a month at 165.00, afterwards falling to 160.32, on October 4, when the basin was reinforced by the supply from Basin No. 4. On December 14 water was flowing over the stone crest of the dam, and so continued, with the exception of four days in December, to the end of the year. The flash-boards were removed on March 22. The highest elevation reached was 167.53, on June 14, and the lowest, 160.32, on October 4.

No work of any importance has been done at Basin 2 during the year, with the exception of the ordinary routine work attending the maintenance of the dam and gate-house, and the management of the water.

BASIN 3.

On Jan. 1, 1887, this basin stood at elevation 175.54, and water was wasting over the stone crest. It continued to overflow until Jan. 8, when, the waste-gates being opened, the surface fell to 158.16, and it was kept at about this height until the gates were closed, on Jan. 10. The surface then rose, and on Feb. 21 began to waste over the dam. On June 13 waste stopped, and the water gradually fell to 171.73, on Oct. 4. After this date the basin filled, and on Dec. 6 waste began over the dam, and has so continued to the present time. The highest elevation reached during

the year was 176.02, on May 1, and the lowest, 158.16, on Feb. 7. During the early spring the basin was purposely kept at low level, when there was an abundance of water running in the river, for the purpose of washing out the basin by increasing the velocity of flow. This carried off some of the detritus left from the work of shallow flowage executed during the previous year.

BASIN 4.

On Jan. 1, 1887, this basin stood at grade 204.93, but rose to 210.55, on Jan. 26, when the gates were partially opened. From this time until March 20 the surface was kept at about 211.00 or 212.00. On March 28 the basin was allowed to rise until it overflowed the stone crest. On May 17 flash-boards were put in place, which carried the water up to very near the high-water line. On July 7 waste stopped. On July 23 waste again began, and continued, with the exception of six days in August, until Sept. 21. On Oct. 4 water was drawn from the basin, and the surface fell to 204.98, on Nov. 15, at which time the gates were closed.

The highest elevation has been 215.10, on June 1, and the lowest, 204.93, on Jan. 1. The basin has not yet filled, but will undoubtedly be running over before long. It is now 207.82.

A considerable amount of work has been done by the regular basin force at this point during the year, both on the embankment of the dam and on the grounds.

About 150 evergreen trees have been set out. During the autumn the old office was changed into a dwelling for the attendant in charge of the dam.

FARM POND.

On Jan. 1, 1887, this pond stood at elevation 149.28. It was kept at about this height during the entire year. The highest point was reached on April 30, viz., 149.44, and the lowest, on July 17, viz., 148.92.

During a portion of the summer, water from the Sudbury basins was run through the Farm-Pond aqueduct on account of the appearance of *algæ* in the water.

The Farm Pond Water Co. have pumped 87,500,000 gallons during the year from Farm Pond, or an average of 240,000 gallons daily.

Water was drawn directly from Farm Pond, from January 1 to June 2, and from the afternoon of August 24 until the end of the year. Water was drawn through Farm-Pond aqueduct from June 2 to August 24.

LAKE COCHITUATE.

On January 1, 1887, the surface of the lake stood at 129.77, 4.59 feet below high water. On January 29, the water having risen to 132.15, the stop-planks were taken out, and waste began over the outlet dam. The greatest height on the weir at any one time was 1.224 feet.

On April 26 the lake reached 134.36 high-water mark. The surface fell steadily during the summer and autumn, the level of the water being reduced by waste into the river, in order to facilitate the work on shallow flowage, which was carried out between September and December. The lowest point reached was on November 10, viz., 125.12. The surface stands at 125.63 at the present time. The water has been hardly up to the average, owing to considerable work of construction going on in the upper portions of the lake.

Inspections of the old cases of sewage pollution in the towns on the sources of supply have been made from time to time, but no regular inspector has been employed. Owing to negotiations now going on between your Board and the towns, no cases have been carried into the courts. The city is still threatened with serious trouble in Brookline, owing to sewage which still percolates into the tunnel.

DUDLEY POND.

We have had no occasion to draw water from this pond during the year.

SUDBURY-RIVER AQUEDUCT.

This structure has been in service during the entire year, with the exception of 23 days, when the flow was stopped to lay a wooden track in one of the tunnels for the cleaning machine.

It has carried to the city a total of 6,124,100,000 gallons, or a daily average of 16,778,400 gallons, a considerable increase over last year. The largest amount run on any one day was 44,000,000 gallons, on August 20, and the smallest, 6,900,000 gallons, May 31.

The upper portions of the aqueduct were cleaned by machine during the summer as far as the Rosemary syphon. The brick-work was very dirty. From Farm Pond to Bacon's waste-weir there was a quantity of black deposit and some sponge.

Considerable work has been done on the first ten miles of

the aqueduct in the way of preparation for the machine. The waste-weirs have been provided with tracks over the catch-basins and through the Rockland and Badger-hill tunnels. The material used for the track was southern pine. The rails are 4 in. by 8 in., and the cross-ties 1 in. by 8 in., with bevelled edges. The ties were placed 10 feet apart; the ends of the ties were fastened to the side-walls with wooden plugs driven into the brick or stone work. The bottoms of these tunnels are of concrete, and quite rough. In the West pipe-chamber an elevator has been constructed to hoist the cleaning-machine out of the aqueduct. It is operated by differential pulleys.

The lower portion of the aqueduct from the East syphon-chamber to Chestnut-Hill reservoir has been cleaned by hand-labor, but this is not as effective as the machine-work. The cleaning was done September 12, 13, and 14.

The fences that cross the aqueduct on the sides of the road crossings, and which were built when the aqueduct was constructed, were found to be in a rotten condition. These fences were built with mortised posts and rails. They have been rebuilt with round chestnut posts and board-rails. The usual attention has been paid to the embankments, loaming, sodding, and top-dressing. The loam was taken from the wooded sections along the line during the winter.

THE COCHITUATE AQUEDUCT.

On Jan. 1, 1887, a depth of 6.5 feet was run to the reservoirs, and so maintained until the 8th, when the flow was reduced to 5.50 feet, and this amount was unchanged until June 27, when 6 inches more was added to the flow. On July 1 this amount was increased to 6.5 feet, and when the surface of the lake reached this point, about September 1, the amount run in the aqueduct has depended upon the level of the lake. We have now $4\frac{1}{2}$ feet running.

On October 24, 25, and 26 the whole length of the aqueduct to Brookline reservoir was cleaned. From the lake to Station 30 there was a strong growth of vegetable matter, but it was only about $\frac{3}{4}$ of an inch long. It gradually diminished to Station 40. From Station 40 to 130 there was a heavy coating of muddy deposit. Spongilla was found principally upon the bottom. From Station 40 to 102 the sponge growth was found in greater quantities than nearer the lake, and was evenly distributed over the brick-work. A considerable growth of sponge of recent formation was found between Station 130 and 270, and it was easily removed.

The whole aqueduct, as far as the Grantville waste-weir,

was very dirty, but gradually decreasing east of this point. The Brookline tunnel gave indications of sewage matter. It is evident that the drainage must come from other places than those already connected with the sewer, and an investigation of this important matter must be made at an early day.

The bushes have been mowed during the year the whole length of the aqueduct. This is found to be the cheapest method of getting rid of them, as a scythe can be used before they get too large. Some work has been begun upon the embankments. They have been neglected for so many years that there is now hardly any loam left upon them. Without this protection the embankments gradually waste away at the upper portions. Some five thousand small pines and shrubs have been dug up and transplanted to the grounds around Chestnut-Hill reservoir, by the aqueduct force, and some fences have been built.

The portion of the Cochituate aqueduct between Chestnut Hill and Brookline reservoirs was shut off from the supply between July 26 and September 3, to allow for the building of a connection chamber at the new high-service works.

CHESTNUT-HILL RESERVOIR.

This reservoir has been in constant use throughout the year. The water has been of good quality.

Another row of English elms has been planted on the north side of Beacon street. Additional shrubs and trees have been planted at various points in the grounds. It will be advisable to limit the planting to native shrubs, and to avoid anything in the way of flowers on the grounds of this reservoir. If this policy is pursued for a number of years, and good judgment used in the planting, this territory will become a very attractive one.

During the winter and spring, at the request of the City Engineer, I took charge of the deep trenching for the foundation of the new high-service works. The digging was begun January 10, and finished March 31. This involved the employment of something like a hundred men, and the trenches had to be closely sheeted to a considerable depth.

The construction of these works has added somewhat to the routine work of the department during the whole year.

The usual meteorological and other observations have been made.

The maintenance of the driveway is now charged to the water-works, no appropriation therefor being made by the City Council.

BROOKLINE RESERVOIR.

The ground and structures at this point are in good order. About half of the water used in Boston has been sent through this reservoir.

No new work has been done during the year.

A table of rainfall at the Chestnut-Hill reservoir is appended, showing the times of beginning and ending of each storm.

Very respectfully yours,

DESMOND FITZGERALD,

Resident Engineer and Superintendent.

Table of Rainfall at Chestnut-Hill Reservoir for year ending Dec. 31, 1887.

DATE.	Inches.	Snow or Rain.	Duration.	DATE.	Inches.	Snow or Rain.	Duration.
Jan. 1	0.04	Mist	During day.	Feb. 24	0.50	Snow and Rain	5.30 a.m. to 11.30 a.m.
" 5	1.10	Rain and	8.00 p.m. to	" 26	0.42	Snow and Rain	1.45 p.m. to 10.30 p.m.
" 6		Snow	1.50 p.m.	Total .	4.44		
" 9	0.22	Snow	11.30 a.m. to 11.00 p.m.	Mar. 5	1.09	Snow and Rain	10.30 p.m. to 10.15 p.m.
" 14	1.24	Snow and	12.10 a.m. to 3.30 p.m.	" 6		Rain	10.15 p.m. to 4.00 a.m.
" 15	0.06	Light Snow	During day.	" 10	1.20	Rain and	11.00 p.m. to 11.00 p.m.
" 17	0.86	Snow and	4.30 a.m. to 11.50 p.m.	" 18	0.07	Snow and	During day.
" 24	0.86	Rain	10.00 a.m. to 6.15 p.m.	" 19	0.10	Mist and	During day.
" 26	0.14	Rain and	11.10 a.m. to 9.30 p.m.	" 22	1.15	Rain and	3.45 a.m. to 10.00 a.m.
" 29	1.05	Rain	2.15 p.m. to	" 23		Snow	
" 30			1.30 p.m.	" 28	1.49	Rain	1.45 a.m. to 12.30 p.m.
Total .	5.57			" 28	0.10	Snow	10.10 p.m. to 12.20 a.m.
Feb. 2	0.41	Snow	8.30 a.m. to 11.30 p.m.	" 29			
" 6	0.06	Snow and	4.00 a.m. to 6.15 p.m.	Total .	5.20		
" 7	0.50	Rain and	6.30 p.m. to 11.00 p.m.	April 2	1.35	Snow	3.00 a.m. to 10.00 p.m.
" 8		Snow and		" 16	0.56	Rain	4.00 a.m. to 6.00 p.m.
" 10	0.27	Rain	12.10 a.m. to 4.00 a.m.	" 18	0.58	Snow	11.30 a.m. to 11.50 p.m.
" 10	0.08	"	12.30 p.m. to 9.30 p.m.				
" 15	0.14	Snow and	1.00 a.m. to 2.00 p.m.				
" 18	1.93	Rain and	9.45 a.m. to 11.00 p.m.				
" 22	0.13	Snow	8.45 a.m. to 5.15 p.m.				

Table of Rainfall at Chestnut-Hill Reservoir. — Continued.

DATE.	Inches.	Snow or Rain.	Duration.	DATE.	Inches.	Snow or Rain.	Duration.
April 23	0.10	Rain	9.00 p.m. to 3.00 a.m.	July 22	1.16	Rain	7.00 a.m. to 1.15 p.m.
“ 24				“ 23	0.24	“	12.20 a.m. to 3.30 a.m.
“ 25	1.11	“	10.00 p.m. to 11.00 a.m.	“ 23	0.67	“	12.45 p.m. to 8.30 p.m.
“ 26				“ 24	0.18	“	10.05 a.m. to 2.45 p.m.
“ 28	0.55	“	3.45 p.m. to 4.00 a.m.	“ 29	0.20	“	6.30 p.m. to 8.15 p.m.
“ 29							
“ 29	0.49	“	4.05 p.m. to 5.00 a.m.	Total .	3.69		
“ 30							
Total .	4.74						
May 7	0.20	Rain	5.00 p.m. to 12.30 a.m.	Aug. 2	0.36	Rain	4.00 a.m. to 1.00 p.m.
“ 8				“ 6	0.13	Showers	1.45 p.m. to 6.30 p.m.
“ 25	0.09	“	8.45 a.m. to 11.45 a.m.	“ 11	0.38	Rain	3.15 p.m. to 10.30 p.m.
“ 26	0.04	“	5.20 a.m. to 6.30 a.m.	“ 18	0.45	“	7.00 a.m. to 6.00 p.m.
“ 26	0.08	“	9.30 p.m. to 11.15 p.m.	“ 20	0.19	“	12.55 p.m. to 2.00 p.m.
“ 27	1.28	Rain and Mist	9.00 p.m. to 9.00 p.m.	“ 20	0.33	“	7.00 p.m. to 10.00 p.m.
“ 28				“ 22	1.69	Rain and showers	4.00 a.m. to 5.45 p.m.
“ 28				“ 23			
“ 29				“ 24			
Total .	1.69			Total .	3.53		
June 1	0.97	Rain	5.30 a.m. to 10.30 a.m.	Sept. 7	0.61	Rain	1.15 a.m. to 5.00 a.m.
“ 2				“ 7			4.45 p.m. to 10.00 p.m.
“ 22	0.27	“	6.20 p.m. to 7.30 a.m.	“ 10	0.24	“	1.00 a.m. to 6.00 a.m.
“ 23				“ 12	0.32	“	9.30 a.m. to 8.00 p.m.
“ 23	0.84	“	9.00 a.m. to 6.45 a.m.	“ 22	0.14	“	3.45 a.m. to 11.00 a.m.
“ 24				“ 29	0.04	“	11.00 a.m. to 6.00 p.m.
Total .	2.08			Total .	1.35		
July 10	1.10	Rain	1.15 a.m. to 3.00 a.m.	Oct. 1	1.00	Rain	5.40 a.m. to 10.30 p.m.
“ 11				“ 2	0.06	“	4.00 p.m. to 7.45 p.m.
“ 12				“ 3	0.09	“	1.30 p.m. to 4.45 p.m.
“ 17	0.14	Showers	3.00 p.m. to 3.30 p.m.	“ 11	0.76	“	1.30 a.m. to 11.45 a.m.
“ 18				“ 21	1.30	“	12.15 a.m. to 1.30 p.m.
				Total .	3.21		

Table of Rainfall at Chestnut-Hill Reservoir. — Concluded.

DATE.	Inches.	Snow or Rain.	Duration.	DATE.	Inches.	Snow or Rain.	Duration.
Nov. 10	0.82	Rain	4.45 p.m. to 10.30 p.m.	Dec. 15	0.68	Rain	11.30 a.m. to 11.30 p.m.
" 15	1.15	"	4.45 a.m. to 1.15 p.m.	" 18	0.52	Rain and Snow	3.20 a.m. to 11.15 p.m.
" 16	0.09	Snow and Rain	4.00 a.m. to 9.15 a.m.	" 21	0.23	Snow	2.00 a.m. to 2.45 p.m.
" 19	0.20	Rain	12.30 p.m. to 7.00 p.m.	" 26	0.47	"	2.00 p.m. to
" 25	0.25	"	1.15 a.m. to 7.00 p.m.	" 27			12.30 p.m.
" 28	0.24	"	12.30 p.m. to 9.00 p.m.	" 28	0.84	Snow and Rain	7.15 a.m. to 6.45 p.m.
Total .	2.75			Total .	3.66		
Dec. 5	0.14	Rain	9.00 a.m. to 2.30 p.m.	Total Rainfall for year 41.91			
" 10	0.78	"	10.45 p.m.				
" 11			to				
" 12			8.45 a.m.				

REPORT OF THE SUPERINTENDENT OF THE EASTERN DIVISION.

JAN. 1, 1888.

HORACE T. ROCKWELL, Esq., *Chairman of Boston Water Board* : —

SIR, — I herewith present my report for the year 1887. I consider the works of this division to be in excellent condition.

Beyond the ordinary amount of labor in the maintenance of the works, the laying of main and service pipes by petitions, the introduction of fire and elevator pipes, etc., etc., there has been laid the 12-inch main to Germantown; the remainder of the "New High-Service" mains; the relaying of 1,528 feet of 48-inch mains, and the taking up of the same number of feet of the old mains on Beacon street, in order to change the location of that line; also the continuance of cleaning the works of the old pipes in Boston, East and South Boston. Last year we cleaned 15,280 feet of 6-inch pipe (omitted in the report of that year); this year 20,280 feet of 12-inch, and 40,932 feet of 6-inch.

The tables that follow show that there have been laid and relaid more main pipes this year than in any year since 1875, the year succeeding the annexation of West Roxbury and Brighton, and more service-pipes than in any year since 1871.

MAIN PIPE.

The length of pipes of different sizes laid and relaid during the year is 130,331 feet, or 24.68 miles.

Whole length laid since commencement of the work	491.24 miles.
Whole length now in service	436.54 miles.

SERVICE-PIPES.

Whole number put in last year	1,835
Length in feet	53,995
Total number to date	55,235

HYDRANTS AND STOPCOCKS.

There have been 245 hydrants and 270 stopcocks established during the year.

Relaying of Enlarged Sizes.

Street.	Between what Streets.	Size now.	No. of Feet.	Size formerly.
Minot	Leverett and Chelsea	10	629	6
Dartmouth	Tremont and Columbus ave.	12	1,170	6
Stanford	Merrimac and Green	8	186	6
Essex	South and Chauncy	8	952	6
Washington	State and Milk	12	750	6
Dover	Tremont and Shawmut ave.	10	801	6
F	Second and Fourth	8	991	6
Battery	Commercial and Hanover	6	351	4
Stanford	Merrimac and Green	8	100	4
Athens	B and Dorchester	6	2,797	4
Silver	A and F	6	51	4
Emerson	L and M	6	221	4
Linden park	Gay and Simmons	6	219	4
Beecher court	Linden park and Linden ave.	6	39	4
Chelsea bridge	Boston and Chelsea	30	1,256	20

TAKEN UP AND ABANDONED.

20-inch	1,256 feet.
6-inch	5,614 "
4-inch	3,848 "

CHANGED.

1 2-inch iron out, 11 1-inch lead put in.			
11 $\frac{1}{2}$	"	"	"
1 $\frac{1}{2}$	"	"	"
1 1	"	lead	"
2 1	"	"	"
1 1	"	"	"
1 $\frac{5}{8}$	"	"	"
24 $\frac{5}{8}$	"	"	"
5 $\frac{5}{8}$	"	"	"
13 $\frac{1}{2}$	"	"	"
11 $\frac{5}{8}$	"	"	"
1 $\frac{3}{4}$	"	"	"
1 2	"	"	"
2 $1\frac{1}{2}$	"	"	"
1 $1\frac{1}{2}$	"	"	"
24 1	"	"	"
5 $\frac{5}{8}$	"	"	"
13 $\frac{5}{8}$	"	"	"

Statement of Location, Size, and Number of Feet of Pipe laid in 1887.

NOTE.—B. indicates Boston; S.B., South Boston; E.B., East Boston; B.H., Boston Highlands; D., Dorchester; W.R., West Roxbury; Chel., Chelsea; Bri., Brighton; Bro'k., Brookline; Chs'n, Charlestown.

In what Street.	Between what Streets.	District.	Size.	Length.
Beacon	Washington and Summit ave.	Bro'k	48	1,528
	Total 48-inch			<u>1,528</u>
Chestnut-hill reservoir lot	Chestnut-hill ave. and Reservoir lane	Bri.	36	52
	Total 36-inch			<u>52</u>
Chestnut-hill reservoir lot	Chestnut-hill ave. and Reservoir lane	Bri.	30	820
Chestnut-hill ave.	Beacon and Brookline line	"	"	180
Brighton	Boston line and R.R. bridge	Bro'k	"	306
Chelsea bridge	Boston and Chelsea	Chel.	"	1,256
	Total 30-inch			<u>2,562</u>
Chelsea bridge	Boston and Chelsea	Chel.	24	160
Day	Creighton and Perkins	B.H.	"	543
Parker-hill reservoir lot	Fisher ave. and the gate-house	"	"	30
Park, Adams, and Chelsea	City square and Chelsea	Chs'n	"	5,196
	Total 24-inch			<u>5,929</u>
Exeter	Huntington ave. and Newbury	B.	16	912
Chestnut-hill ave.	Beacon and Brookline line	Bri.	"	181
	Total 16-inch			<u>1,093</u>
Dartmouth	Tremont and Columbus ave.	B.	12	1,170
Jersey	Beacon and Boylston	"	"	1,023
Boylston	Jersey and Audubon road	"	"	957
Audubon road	From Boylston	"	"	1,000
Washington	State and Milk	"	"	750
Westland ave.	Parker and Rumford road	"	"	254
Rumford road	Westland and Boylston	"	"	1,180
West Newton	Huntington ave. and B. & Prov. R.R.	"	"	201
Boylston	Parker and Audubon road	"	"	325
	Carried forward			<u>6,860</u>

Statement of Location, Size, etc. — *Continued.*

In what Street.	Between what Streets.	District.	Size.	Length.
	<i>Brought forward</i>			6,860
Boston	Washburn and Blake	S.B.	12	466
Ford	Breed and Saratoga	E.B.	"	20
Walley	Leyden and Gladstone	"	"	414
Elm-hill ave.	Howland and Crawford	B.H.	"	100
Humboldt	Waumbeck and Seaver	"	"	1,967
Glen road	Erie ave. and Read ave.	Dor.	"	154
Richfield	Olney and Davidson place	"	"	307
Oakland	River and Rockville	"	"	193
Adams	Centre and King	"	"	805
East Chester Park . .	Clapp and Boston	"	"	320
Washington	Fuller and Fairmount	"	"	262
Southern ave.	Whitfield and Bernard	"	"	741
Warner ave.	Harvard and Park	"	"	195
Westville	Bowdoin and Ditson	"	"	1,168
Codman	Adams and Carruth	"	"	380
Coolidge ave.	Warner ave. and Bernard	"	"	136
Lauriat ave.	Bernard ave. and Blue Hill ave.	"	"	1,564
Prospect ave.	Norfolk and Milton ave.	"	"	145
Wesley ave.	From Savin-hill ave.	"	"	180
Sydney	Savin-hill ave. and Belfort	"	"	1,027
Hewlett	Walter and Centre	W. R.	"	1,686
Dudley ave.	Washington and Birch	"	"	108
Neponset ave.	Hyde-Park ave. and Canterbury	"	"	1,022
Metropolitan ave. . .	Washington and Poplar	"	"	2,726
May	Pond and Centre	"	"	49
Canterbury	Mt. Hope ave. and Prov. R.R. bridge	"	"	1,558
Centre	Spring and Grove	"	"	3,522
Grove	Centre and Washington	"	"	3,090
Hyde Park ave.	From Walkbill	"	"	145
Beech	Washington and Poplar	"	"	2,729
Walnut	School and Sigourney	"	"	620
Washington	Grove and Rockland	"	"	1,448
Poplar	Dale and Beech	"	"	136
Baker	Spring and Belle ave.	"	"	477
	<i>Carried forward</i>			29,860

Statement of Location, Size, etc. — *Continued.*

In what Street.	Between what Streets.	District.	Size.	Length.
	<i>Brought forward</i>			29,860
Gardner	Baker and Adams	W.R.	12	1,954
La Grange	Linnett and Lark	"	"	1,682
Shaw	La Grange and Sparrow	"	"	841
Florence	Ashland and Sycamore	"	"	120
Florence	Blakemore and Sherwood	"	"	194
Washington	Walkhill and Hyde Park aves.	"	"	237
Everett	North Beacon and Braintree	Bri.	"	386
Roxbury ave.	From Englewood ave.	"	"	561
Chestnut-hill reservoir lot	Opp. engine-house	"	"	23
	Total 12-inch			<u>42,718</u>
Minot	Leverett and Nashua	B.	10	629
Beacon	West Chester Park and Ipswich	"	"	601
Dover	Shawmut ave. and Tremont	"	"	801
Belvidere	From West Chester Park	"	"	78
Byron	Saratoga and Pope	E.B.	"	960
Harvest	Boston and Dorchester ave.	Dor.	"	480
Idaho	From River	"	"	103
Savin-hill ave.	Wesley ave. and Grampian way	"	"	863
Oriole	Park and Bellevue	W.R.	"	894
Bellevue	Oriole and Linnett	"	"	357
	Total 10-inch			<u>5,771</u>
Ipswich	Beacon and Marlboro'	B.	8	47
Staniford	Green and Merrimac	"	"	525
West Newbury	Ipswich and Brookline ave.	"	"	38
Essex	South and Chauncy	"	"	952
F	Second and Fourth	S.B.	"	991
Leyden	From Walley	E.B.	"	1,510
Gladstone	Walley and Breed	"	"	465
Homestead	Humboldt and Walnut aves.	B.H.	"	292
Day	Creighton and Atwood ave.	"	"	115
Puritan ave.	From Richfield	Dor.	"	212
Cushing ave.	Upham and Jerome	"	"	119
	<i>Carried forward</i>			<u>5,266</u>

Statement of Location, Size, etc. — *Continued.*

In what Street.	Between what Streets.	District.	Size.	Length.
	<i>Brought forward</i>			5,266
Argyle	Ashmont and Welles ave.	Dor.	8	328
Norfolk	Walk Hill and R.R. bridge	"	"	153
Gleason	Harvard and McClellan ave.	"	"	301
Back	Austin and Morton	"	"	544
Alban	Ashmont and Welles ave.	"	"	122
McClellan ave.	Erie ave. and Gleason	"	"	240
Dorchester ave.	Bailey and Codman	"	"	1,398
Bellevue ave.	From Lauriat ave.	"	"	454
Granite ave.	Milton and R.R. crossing	"	"	892
Dorchester ave.	Ashmont and Delle	"	"	434
Bellevue	Linnett and Rutledge	W. R.	"	483
Linnett	Bellevue and La Grange	"	"	915
Sedgwick	Elm and South	"	"	129
St. John	Centre and Rockview	"	"	430
Willow	Centre and Weld	"	"	1,713
Walk Hill ave.	From Walkhill	"	"	824
Summit ave.	Metropolitan ave. and Hemmen	"	"	657
Clarendon ave.	Kittredge and Augustus ave.	"	"	279
Kittredge ave.	Albano and Clarendon ave.	"	"	39
Ashland	Canterbury and Berry	"	"	173
Cass	Centre and Oak ave.	"	"	1,010
Grove	Washington and Dedham line	"	"	1,259
Central	Centre and B. & Prov. R.R.	"	"	414
Walter	Hewlett and Peter	"	"	380
Symmes	Fairview and Walter	"	"	60
Mt. Vernon	Eastburn and Rockland	Bri.	"	372
Wexford	Market and Hillside ave.	"	"	1,349
Braintree	Milton and Everett	"	"	52
Arlington	From Parsons	"	"	224
Matchett	From Washington	"	"	264
Chestnut-hill reservoir lot	Stable and Reservoir lane	"	"	621
	Total 8-inch			21,779
Reed	Colburn and Walnut place	B.	6	12
	<i>Carried forward</i>			12

Statement of Location, Size, etc. — *Continued.*

In what Streets.	Between what Streets.	District.	Size.	Length.
	<i>Brought forward</i>			12
Walnut place	From Reed	B.	6	100
Derby place	Washington and Clifton place	"	"	127
Battery	Commercial and Hanover	"	"	351
East Concord	Albany and Harrison ave.	"	"	528
East Springfield	Albany and Harrison ave.	"	"	692
Falmouth	West Chester Park and Dalton	"	"	503
Commonwealth ave.	Jersey and Kenmore	"	"	1,203
Caledonia	West Chester Park and Falmouth	"	"	519
St. Botolph	Cumberland and West Chester Park	"	"	209
Kenmore	Commonwealth ave. and Beacon	"	"	220
Ipswich	Boylston and B. & A. R.R.	"	"	517
Washington	Dover and Ashland place	"	"	254
St. Paul	Falmouth and Caledonia	"	"	354
Haviland	West Chester Park and Parker	"	"	186
Newbury	West Chester Park and Ipswich	"	"	544
Hereford	Boylston and Newbury	"	"	185
Boylston	Ipswich and Rumford road	"	"	45
M	Eighth and the water	S. B.	"	461
Ninth	L and M	"	"	320
Athens	B and Dorchester	"	"	2,797
H	Broadway and Third	"	"	77
G	Broadway and Third	"	"	17
Fifth	G and H	"	"	154
Sixth	H and I	"	"	259
Silver	Across F	"	"	51
East Fourth	G and I	"	"	510
Emerson	L and M	"	"	221
Ceylon	Preble and Hyde	"	"	310
Falcon	Brooks and Glendon	E. B.	"	1,181
Bennington	Byron and Wordsworth	"	"	253
Pope	Curtis and Moore	"	"	113
Bayswater	Saratoga and Washburn	"	"	857
Collins	Bayswater and Austin ave.	"	"	358
London Park	Gay and Simmons	B. H.	"	398
	<i>Carried forward</i>			14,886

Statement of Location, Size, etc. — *Continued.*

In what Street.	Between what Streets.	District.	Size.	Length.
	<i>Brought forward</i>			14,886
Beecher court	Linden park and Linden ave.	B. H.	6	39
Haynes Park	From Warren	"	"	235
A court	From Parker	"	"	120
Maple	Georgia and Cheney	"	"	305
Howard	Gerard and Magazine	"	"	205
Pierpont	Station and Prentiss	"	"	143
Montrose	Warren and Moreland	"	"	148
Armstrong	Ashley and Mozart	"	"	213
Ashley	Chestnut ave. and Armstrong	"	"	337
Thwing terrace	From Highland	"	"	339
Fenwick	Circuit and Hulbert	"	"	238
Oregon	Smith and Conant	"	"	48
Ruthven	Humboldt ave. and Nasby	"	"	68
Hutchins	Humboldt ave. and Harold	"	"	415
Marshfield	Bachelder and Clifton	"	"	48
Wanmbeck	Humboldt ave. and Warren	"	"	22
Howland	Humboldt ave. and Elm-hill ave.	"	"	1,150
Wenonah	Wanmbeck and Elm-hill ave.	"	"	190
Bolster	Wyman and Mozart	"	"	72
Centre	New Heath and Highland	"	"	145
Wait	Hillside and Tremont	"	"	238
Roekingham place	Linden park and Cabot	"	"	182
Farnham	Reed and Gerard	"	"	483
Southwood	From Blue Hill ave.	"	"	91
Hazelwood	Munroe and Townsend	"	"	405
Burt ave.	Ashmont and Washington	Dor.	"	709
Foster	Dorchester ave. and Freeman	"	"	63
Whitfield	Wheatland ave. and Park	"	"	48
Union ave.	Rosseter and Geneva ave.	"	"	88
Brent	Washington and Carlisle	"	"	230
Beale	Dorchester ave. and Carruth	"	"	141
Gouldville terrace	From Brook ave.	"	"	213
Davidson place	From Richfield	"	"	155
Highland ave.	From Minot	"	"	305
	<i>Carried forward</i>			22,717

Statement of Location, Size, etc. — *Continued.*

In what Street.	Between what Streets.	District.	Size.	Length.
	<i>Brought forward</i>			22,717
Dorset	Boston and Dorchester ave.	Dor.	6	314
Evans	Corbett and Nelson	"	"	110
Clarence place	Herbert and Whitfield	"	"	131
Harvard ave.	From Harvard	"	"	360
Kenwood	From Allston	"	"	180
Sawyer ave.	Cushing and Downer ave.	"	"	250
Pierce ave.	Plain and Newhall	"	"	146
Bellevue terrace . . .	From Quiney	"	"	333
Brook ave. place . . .	From Brook ave.	"	"	114
Field court	From Willow	"	"	212
Sidney place	From Dudley *	"	"	57
New Minot	Fredericka and Adams	"	"	252
Stanton ave.	Evans and Norfolk	"	"	211
Delle	From Dorchester ave.	"	"	706
Fairfax	Beaumont and Carruth	"	"	314
Kilton	Norfolk and Stanton ave.	"	"	293
King	Adam and Train	"	"	292
Lombard ave.	Carruth and Bushnell	"	"	50
Freeman	Charles and Foster	"	"	150
Hillside	Adam and Rockview	"	"	333
Rockview	From Hillside	"	"	203
Malvern	Adam and Milton	"	"	203
Bicknell ave.	From Harvard	"	"	312
Shelton	From Adam	"	"	909
Auckland	From Savin-hill ave.	"	"	212
Wilton ave.	Norfolk and Lauriat ave.	"	"	183
Buttonwood	Vernon and Locust	"	"	60
Wheatland ave. . . .	Kilton and the railroad	"	"	135
Nonquit	From Dudley	"	"	188
Waterloo	From Harvard	"	"	60
Bellevue	Trull and Quiney	"	"	103
Whitman	From Norfolk	"	"	389
Gibson	Adam and Dorchester ave.	"	"	151
Brook place	Clifton and Dudley	"	"	122
	<i>Carried forward</i>			30,745

Statement of Location, Size, etc. — Continued.

In what Street.	Between what Streets.	District.	Size.	Length.
	<i>Brought forward</i>			30,745
Coolidge ave.	From Bernard	Dor.	6	412
Warner ave.	Coolidge ave. and Park	"	"	213
Tappan	From South	W.R.	"	481
Central ave.	From Washington	"	"	234
Brookside ave.	Germania and Cornwall	"	"	63
Hagar	Thomas and Eliot	"	"	144
Starr lane	Seaverns ave. and Centre	"	"	36
Himman	From Summit	"	"	536
Peter	Skinner and Walter	"	"	176
Gilman	Canterbury and Berry	"	"	266
Sherwood	Ashland and Prospeet ave.	"	"	115
Ashland	Brown ave. and Sherwood	"	"	95
Wren	Rutledge and Oriole	"	"	466
Call	Starr and Gordon	"	"	211
Franklin Park	From Walnut	"	"	866
Union terrace	Forest hills ave. and Morton	"	"	412
Cypress	Spring and Baker	"	"	77
Prospect ave.	From Baker	"	"	442
Rockland	Washington and Dedham line	"	"	1,262
Paul Gore	Chestnut ave. and Centre	"	"	204
German	Washington and Grove	"	"	1,120
Carolina ave.	South and John A. Andrew	"	"	412
Ashland	Cass and Johnson	"	"	659
Johnson	From Ashland	"	"	488
Pine	Brown ave. and Sherwood	"	"	193
Sparrow	Shaw and Washington	"	"	396
School	Amory and Copley square	"	"	96
Woodman	Custer and Jamaica	"	"	309
A court	From Woodman	"	"	194
Alarie	From Centre	"	"	247
Greenwood place	From Greenough	"	"	164
Richards ave.	Hyde Park and Huntington ave.	"	"	287
Oak ave.	From Cass	"	"	414
Huntington ave.	Richards ave. and Hyde Park ave.	"	"	351
	<i>Carried forward</i>			42,721

Statement of Location, Size, etc.— *Concluded.*

In what Street.	Between what Streets.	District.	Size.	Length.
	<i>Brought forward</i>			42,721
A court	From Washington	W.R.	6	227
A new street	From Spring	"	"	221
A new street	From Neponset ave.	"	"	137
Nelson	Boylston and Spring Park	"	"	24
Linnett	Lennett and Martin	"	"	714
Eastburn	Washington and Mt. Vernon	Bri.	"	10
High	Dunboy and Bigelow	"	"	259
Dunboy ave.	Bigelow and High	"	"	428
Kelly court	From Western ave.	"	"	276
Riverdale	Vernon and Western ave.	"	"	499
Rockland	From Chestnut-hill ave.	"	"	110
Lexington ave.	Washington and Union	"	"	345
A new street	From Cambridge	"	"	245
Crescent ave.	From Washington	"	"	976
Mansfield	Cambridge and Hill ave.	"	"	60
Gordon	Cambridge and Orchard	"	"	25
Hillside ave.	From Wexford	"	"	210
Highborn	North Beacon and Herriek	"	"	187
Parsons	Bennett and Surry	"	"	132
Chestnut-hill reservoir lot	Opposite engine house	"	"	40
	Total 6-inch			47,926
Buckingham place	From Buckingham	B.	4	89
A new street	From Hereford	"	"	141
Scott place	From Fifth	S.B.	"	143
Ninth-st. place	From Ninth	"	"	38
A court	From Heath	B.H.	"	104
Hayden court	From Washington	"	"	118
Oakland park	From Oakland	"	"	83
Chadwick court	From Chadwick	"	"	83
A court	From Leonard	Dor.	"	174
	Total 4-inch			973

**Statement of Location, Size, and Number of Feet of Pipe
Relaid and Abandoned in 1887.**

In what Street.	Between what Streets.	District.	Size.	Length.	Size of Pipe as relaid.
Minot	Leverett and Nashua	B.	6	623	10-in.
Dartmouth	Tremont and Columbus ave.	"	"	1,170	12
Staniford	Merrimac and Green	"	"	186	8
Essex	South and Chauncy	"	"	952	8
Washington	State and Milk	"	"	750	12
Dover	Tremont and Shawmut ave.	"	"	801	10
Livingston	Charles and the water	"	"	117	
F	Second and Fourth	S.B.	"	991	8
Copley	From School	W.R.	"	15	
	Total 6-inch			5,611	
Battery	Commercial and Hanover	B.	4	351	6
Staniford	Merrimac and Green	"	"	100	8
Province court	From Province	"	"	70	
Athens	B and Dorchester	S.B.	"	2,797	6
Silver	A and F	"	"	51	6
Emerson	L and M	"	"	221	6
Linden Park	Gay and Simmons	B.H.	"	219	6
Beecher court	Linden Park and Linden ave.	"	"	39	6
	Total 4-inch			3,848	
Chelsea bridge	Boston and Chelsea	Chel.	20	1,256	30
	Total 20-inch			1,256	
<i>Lowered.</i>					
Beacon	Summit ave. and Washington st.	Bro'k	48	385	
Sherwood	Pine and Garden	W.R.	6	178	
Pine	Brown ave. and Sherwood	"	"	50	
Shirley	George and Dudley	B.H.	"	255	
<i>Raised.</i>					
Boylston	West Chester Park and Parker	B.	12	300	
<i>Relaid.</i>					
Beacon	Summit ave. and Washington	Bro'k	48	1,528	

Table showing the Length of Supply and Distributing Mains laid during the year 1887, and the Length connected with the Sudbury and Cockshute Works, January 1, 1888.

DIAMETER OF PIPE IN INCHES.															Totals.
	60	48	40	36	30	28	24	20	16	12	10	8	6	4	
EASTERN DIVISION.															
Length in use Jan. 1, 1887		25,571	23,054	20,792	43,472	244	38,354	44,846	52,177	615,373	20,935	220,454	920,224	137,860	2,163,356
Stopcocks in same		1	7	12	16		35	30	85	912	14	408	2,291	607	4,418
Length laid or relaid during the year		1,528		52	2,562		5,929		1,093	42,718	5,771	21,779	47,926	973	130,331
Stopcocks in same					3		6	2	2	59	10	29	149	10	270
Length abandoned during the year		1,528						1,256					5,611	3,848	12,243
Stopcocks in same										1			13	7	21
Length in use Jan. 1, 1888		25,571	23,054	20,844	46,034	244	44,283	43,590	53,270	658,991	26,706	242,233	962,539	134,985	2,281,444
Stopcocks in same		1	7	12	19		40	31	87	970	24	437	2,427	610	4,667
WESTERN DIVISION.															
Length in use Jan. 1, 1888	266	16,051	1,435	1,166	2,140				20	2,043			360		23,481
Stopcocks in same		5		3					2	4			2		16
Total length connected with the Works, Jan. 1, 1888	266	41,622	24,489	22,010	48,174	244	44,283	43,590	53,290	660,134	26,706	242,233	962,899	134,985	2,304,925 ft. equal to 436.54 miles.

Repairs of Pipes during the Year 1887.

WHERE.	Diameter of Pipes in Inches.																	Total.
	40	36	30	28	24	20	16	12	8	6	4	3	2	1½	1¼	1	¾	
Boston	1	1	2	6	1	2	8	18	10	41	21	5	6	19	1	9	7	507
South Boston						2		2		4	2		1					119
East Boston						8		2		5	1							73
Boston Highlands						3		3	1	8	2		10			5	1	185
Dorchester								4		9	1		2			1		85
West Roxbury								1		2			5					46
Brighton										1								26
Totals	1	1	2	6	1	15	8	30	11	70	27	5	24	19	1	15	8	1,041

Of the leaks that have occurred in pipes of 4 inches and upwards: joints, 83; settling of earth, 12; defective pipe, 11; defective stopcock, 24; defective packing, 37; frost, 2; by blasting, 1; bolts eaten off by salt water, 1; dropping of gas syphon on pipe, 1. Total	172
Of 3-inch pipes and in service-pipes: joints, 34; settling of earth, 161; settling of boxing, 3; defective pipe, 168; defective packing, 13; defective coupling, 19; defective faucet, 2; defective valves, 6; faucet punched out, 2; faucet pulled out, 3; faucet blown out, 1; faucet loose at main, 3; faucet broken off at main, 1; pipes not in use, 11; gnawed by rats, 13; struck by pick, 91; cut by parties, 6; dumping of stone, 2; by frost, 3; by blasting, 5. Total	556
Stoppages by rust, 226; by dirt, 45; by fish, 16; by frost, 17; by gasket, 6; by solder, 3. Total,	313
Total	1,041

Statement of Leaks and Stoppages, 1850-1887.

YEAR.	DIAMETER.		Total.
	Four inches and upwards.	Less than four inches.	
1850	32	72	104
1851	64	173	237
1852	82	241	323
1853	85	260	345
1854	74	280	254
1855	75	219	294
1856	75	232	307
1857	85	278	363
1858	77	324	401
1859	82	449	531
1860	134	458	592
1861	109	399	508
1862	117	373	490
1863	97	397	494
1864	95	594	489
1865	111	496	607
1866	139	536	675
1867	122	487	609
1868	82	449	531
1869	82	407	489
1870	157	707	926
1871	185	1,380	1,565
1872	188	1,459	1,647
1873	153	1,076	1,229
1874	434	2,120	2,554
1875	203	725	928
1876	214	734	948
1877	109	801	910
1878	213	1,024	1,237
1879	211	995	1,206
1880	135	929	1,064
1881	145	833	1,028
1882	170	1,248	1,248
1883	171	782	953
1884	253	1,127	1,380
1885	111	638	749
1886	150	725	875
1887	172	869	1,041

HYDRANTS.

During the year 245 hydrants have been established and 63 abandoned.

	ESTABLISHED.					ABANDONED.					
	Boston Lowry.	Post.	Lowry.	Boston.	Total.	Boston Lowry.	Post.	Lowry.	Boston.	Total.	Total Difference.
Boston	4	17	21	3	42	3	.	.	19	22	20
South Boston	.	10	17	1	28	1	.	.	12	13	15
East Boston	.	9	4	.	13	.	.	.	1	1	12
Boston Highlands	5	7	2	.	14	.	.	1	3	4	10
Dorchester	11	33	2	4	50	5	.	4	4	13	37
West Roxbury	14	55	7	.	76	4	.	.	5	9	67
Brighton	2	18	1	1	22	.	.	.	1	1	21
	36	149	54	6	245	13	.	5	45	63	182

Total number up to January 1, 1888.

	Boston Lowry.	Boston Y.	Post.	Lowry.	Boston.	Total.
Boston	51	.	143	551	677	1,422
South Boston	16	1	62	178	295	552
East Boston	18	.	52	127	156	353
Boston Highlands	37	.	67	651	119	874
Dorchester	102	.	148	569	88	907
West Roxbury	104	.	271	111	57	543
Brighton	32	.	174	63	39	308
Deer Island	.	.	16	.	.	16
Brookline	.	.	.	5	3	8
Chelsea	.	.	.	.	7	7
	360	1	933	2,255	1,441	4,990

131 hydrants have been taken out and replaced by new, or repaired ones, and 215 boxes have been taken out and replaced by new ones. The hydrants have had the usual attention paid them.

STOPCOCKS.

270 new stopcocks have been established this year; 160 boxes have been taken out and replaced by new ones. The stopcocks have had the proper attention paid them.

Respectfully submitted,

EZEKIEL R. JONES,
Superintendent Eastern Division.

REPORT OF THE SUPERINTENDENT OF THE MYSTIC DEPARTMENT.

MYSTIC DEPARTMENT, BOSTON WATER-WORKS,
CHARLESTOWN DISTRICT, Jan. 1, 1888.

COL. HORACE T. ROCKWELL, *Chairman Boston Water Board*:—

SIR,—The report of this department for the year ending Dec. 31, 1887, is herewith submitted.

MYSTIC LAKE.

With the rainfall of this year all danger of pumping at the lake has passed. The lake has stood higher this year than for a great number of years past, and at this date is almost full. Owing to the height of water we have been unable to do any cleaning below Whitney's dam, and have confined our work to Wedge Pond and Horn-Pond stream. This stream has been cleaned its whole length, and is now in better condition than ever, as I can find no record of any cleaning having been done on that stream. We have had no complaints of the water this past year, which seems proof that the annual cleaning has somewhat improved the water. The pollution has been thoroughly looked after, and there still continues an improvement in the visible cases, though the invisible ones, owing to the nature of the soil, must continue to increase. The building in the towns of Woburn, Winchester, and Stoneham is rapidly increasing, and, owing to the lack of sewers, the quantity of indirect drainage must continue to increase. The gate-house and pump-houses are in good condition. The house now occupied by the keeper should be condemned, and a new one built in a more healthy location. Some of the fences need rebuilding this year. The grading of the land has been continued the past year.

MYSTIC-VALLEY SEWER.

This branch of the department remains the same as last year; the amount of sewage slightly increases. During the past year a number of experiments for the treatment of the sewage matter have been tried.

The new buildings and pumps mentioned in my last report have not been built, as we thought it best to know just what would be needed; we shall have to replace the engine this year. The sewer and catch-basins are all in good condition.

CONDUIT.

The conduit was cleaned in June and September; at both times found plenty of sponge and mud; it was thoroughly swept and scrubbed, and the dirt taken out. I would again recommend the enlargement of the gate-house at the river end, and the building of more man-holes.

RESERVOIR.

The banks of the reservoir were thoroughly top-dressed with manure last year, and again this; the grass shows the improvement. The roads and walks are in good condition. The gate-house will need some slight repairs this year. The whole reservoir should be cleaned out this year, and the stone-work pointed.

ROADS AND GROUNDS.

At the engine-house the edgestones have been reset, the sidewalks and gutters have been concreted, and part of the street macadamized; shall continue the work the present year.

PUMPING-SERVICE.

The boilers and pumps have needed few repairs the past year, and remain in about the same condition. They are old, and begin to show signs of wear. We are at present rebuilding the roof of the engine-house. We found, on examination, that the old trusses were unsafe, and we are putting in six new ones. When the new ones are in position the roof will be supported on them and the old ones removed.

The roof of the coal-bunker has rotted away the past season. I recommend that a shed-roof be built over it. The dwelling-house occupied by the engineer needs considerable repairs, and the plumbing in the same will have to be renewed this year.

DISTRIBUTION-PIPES.

These have been extended by the addition of 660 feet 16-inch, 156 feet 6-inch; 5,692 feet of cement-lined pipe have been replaced with cast-iron. We have also laid 5,196 feet of 24-inch pipe for connection with the Cochituate works.

HYDRANTS AND GATES.

Two additional Lowrys and 6 Boston Lowrys have been placed this year; 1 old pattern Lowry replaced with a new one; 2 Boston Lowrys substituted for posts, and 6 posts for flush hydrants. There have been 17 hydrants repaired and 12 rotten hydrant-boxes replaced; 1 4-in., 3 6-in., 1 8-in. gates have been added; 4 4-in., 18 6-in., 2 8-in. have been replaced with new; 5 2-in., 2 6-in. blow-offs have been established, 19 gates repaired, 40 gate-boxes renewed.

SERVICE-PIPES AND BOXES.

Forty-three new services were laid and 130 repaired, in which 1,253 feet of lead pipe were used; 35 $\frac{1}{2}$ -in. services replaced by larger ones; 37 leaks were repaired. There have been 34 stoppages by eels, and 24 by rust; there have been 278 wooden service-boxes replaced by cast-iron.

FOUNTAINS.

I would recommend that the cast-iron fountains on Austin and Bunker-Hill streets be removed, and stone troughs substituted, and that a new one be established on Chelsea street, near the bridge.

Number of New Services and Length in Feet.

LOCATION.	Number.	Feet.
Charlestown	43	1,102
Somerville	370	13,867
Chelsea	104	2,988
Everett	177	3,894
Total	694	21,851

Number and Length of Services connected with the Works Jan. 1, 1888.

LOCATION.	Charlestown.	Somerville.	Chelsea.	Everett.	Total.
No. of services	5,737	4,096	4,821	1,255	16,809
Length in feet	153,662	169,738	129,671	27,830	480,901

480,901 feet, or 92 miles 5,140 feet.

Breaks and Leaks in Distribution-Pipes.

LOCATION.	SIZE OF PIPES.					Total.
	10"	8"	6"	4"	3"	
Charlestown	...	...	1	11	...	12
Somerville	...	5	40	32	6	83
Chelsea	7	10	11	24	5	57
Everett	...	1	2	...	...	3
Total	7	16	54	66	11	155

Extension of Distribution-Pipes.

LOCATION.	SIZE OF PIPES.						Total.
	16"	10"	8"	6"	4"	2"	
Crafts street	...	...	...	48	...	...	48
Park street	660	...	...	...	...	...	660
Hamblin street	...	...	...	108	...	...	108
Somerville	...	...	15	8,990	726	173	9,904
Chelsea	...	4,600	...	4,446	866	...	9,912
Everett	...	...	...	1,889	1,318	...	3,207
Total	660	4,600	15	15,481	2,910	173	23,839

Distribution-Pipes Relaid.

LOCATION.	ORIGINAL SIZE.	4''	6''	8''	10''	Total.
	Inches.	Inches.	Inches.	Inches.	Inches.	
Henley street	6	24	396	.....	.....	420
Putnam street	4	12	300	.....	.....	312
Harvard street	4	.....	348	.....	.....	348
Polk street	4	.....	600	.....	.....	600
Concord street	4	12	396	.....	.....	408
Trenton street	4	.....	420	.....	.....	420
School street	4	.....	540	.....	.....	540
Cross street	4	.....	420	.....	.....	420
Forbush court	4	240	.....	.....	.....	240
Albion place	4	.....	348	.....	.....	348
Edgeworth street	4	.....	444	.....	.....	444
Prospect street	4	.....	708	.....	.....	708
Park street	4	.....	300	.....	.....	300
Tufts' wharf	2	96	.....	.....	.....	96
Somerville . . . . .	.....	31	3,136	485	.....	3,652
Chelsea . . . . .	.....	126	456	.....	90	672
Total . . . . .	.....	541	8,812	485	90	9,228

Number of Gates Connected with the Works.

SIZE.	30-inch.	24-inch.	20-inch.	16-inch.	12-inch.	10-inch.	8-inch.	6-inch.	4-inch.	3-inch.	Totals.
Charlestown	11	7	4	21	30	12	50	176	156	12	479
Somerville					6	5	10	223	215	3	462
Chelsea				1		14	14	34	164	30	257
Everett						3	3	41	52	4	103
Totals	11	7	4	22	36	34	77	474	587	49	1,301

Number of Hydrants Connected with the Works.

HYDRANTS.	Charles-town.	Somerville.	Chelsea.	Everett.	Pumping Station, West Medford.	24-inch Main, Medford.	30-inch Main, Medford.	24-inch Main, Somerville.	Private.	Totals.
Lowry	172	2		1					9	184
Boston Lowry	23									23
Post	36	353	154		2		2	5	46	598
Flush	8			82	1	6			33	130
Totals	239	355	154	83	3	6	2	5	88	935

Summary of Pipes connected with the Works Jan. 1, 1888.

LOCATION.	SIZE OF PIPE.												TOTAL.
	36-inch.	30-inch.	24-inch.	20-inch.	16-inch.	12-inch.	10-inch.	8-inch.	6-inch.	4-inch.	3-inch.	2-inch.	
Charlestown	974	24,869	16,807	6,180	18,860	14,600	4,700	22,072	54,708	28,368	2,400		194,596
Somerville						8,614	4,586	38,647	122,885	91,763	7,872	2,949	277,316
Chelsea					1,460		20,127	11,487	35,854	78,481	18,640		166,049
Everett							7,128	2,481	42,207	36,394	914	215	89,399
Totals	974	24,869	16,807	6,180	20,320	23,214	36,541	74,687	255,714	235,004	29,826	3,164	727,360

727,360 feet, or 137 miles 4,000 feet.

Yours most respectfully,

J. HENRY BROWN,
Superintendent.

REPORT OF THE SUPERINTENDENT OF THE METER DIVISION.

OFFICE OF SUPERINTENDENT OF METER DIVISION,
221 FEDERAL STREET, BOSTON, Jan. 1, 1888.

HORACE T. ROCKWELL, Esq., *Chairman Boston Water Board*:—

SIR,—The annual report of the Meter Division for the year ending Dec. 31, 1887, is herewith submitted.

During the year there have been purchased for the Cochituate Department 496 meters, of the following kind and size:—

	2'	1½''	1''	¾''	⅝''	Total.
Worthington	12	21	40	50	.....	123
"B. W. W." . . . . .	.....	.....	.....	324	.....	324
Crown . . . . .	.....	.....	.....	10	15	25
Balance Valve . . . . .	.....	.....	.....	6	.....	6
Star . . . . .	.....	.....	.....	6	.....	6
Thomson . . . . .	.....	.....	2	3	.....	5
Hersey . . . . .	.....	.....	.....	.....	6	6
Desper . . . . .	.....	.....	.....	1	.....	1
	12	21	42	400	21	496

In the Cochituate Department there have been 86 additional meters applied, and 383 discontinued, making the total number in service to date 3,128.

1,121 changes have been made. Of this number 356 were taken out especially for test, 32 for enlargement, 13 clocks broken or defaced, 74 leaking, 7 levers and pistons broken, 13 stoppages in pipes, 84 ordered out as not working satisfactorily, 28 frozen, 5 on account of noise of meter when working, and 509 for various causes.

Meters in Service, Cochituate Department, Jan. 1, 1888.

	6"	4"	3"	2"	1½"	1"	¾"	⅝"	½"	Total.
Worthington		6	13	73	51	429	87	200	...	859
"B. W.W."							301			301
Crown	1	11	16	25	35	148	110	1,077	...	1,423
Tremont						45	441			486
Desper							2	9	...	11
Ball & Fitts						6	7	12	...	25
Balance Valve							6			6
Star							5			5
Hersey								6	...	6
Spooner								1	...	1
Thomson							1		...	1
Frost					1	1	1		1	4
	1	17	29	98	87	629	961	1,305	1	3,128

193 meters and 28 service pipes have been found leaking and repaired, 61 clocks taken off and replaced by new, and the location changed of 34 meters.

48 new street boxes have been set, 26 decayed boxes taken out and replaced by new, 29 repaired and 68 removed, and the streets put in good condition.

All outside boxes have been packed with hay to protect the meters from frost.

The couplings on 410 meters have been sealed with composition clamps, which prevent the meter being taken off without the knowledge of this department.

116 meters have been sent to the factory for repairs, viz., 52 Worthingtons, 49 Crowns, 4 Ball & Fitts, 11 Desper; 162 have been condemned as worn out in service.

At the yard 1,616 meters were tested, 64 taken apart, cleaned and repaired; 35 clocks and 98 gears have been changed to adjust meters to the proper test.

All new meters are tested on full $\frac{1}{2}$, $\frac{1}{4}$ and $\frac{1}{8}$ streams before being placed in service.

MYSTIC DEPARTMENT.

Total number of meters in service to date, 420.

During the year 25 additional meters have been applied, 77 discontinued, and 260 changes made, for various causes.

By-passes have been placed on the following meters: Crowns, 2 6-in., 2 4-in., 1 3-in.; Worthington, 2 4-in. and 1 3-in. The object being to give a positive supply of water in case of fire, as the water can be shut off from the meter and be allowed to pass around the same.

Meters in service, Mystic Department, to date.

	6-in.	4-in.	3-in.	2-in.	1½-in.	1-in.	¾-in.	½-in.	Total.
Worthington		6	2	33	4	73	50	34	201
" B.W.W."							4		4
Crown	2	5	6	8	2	22	43	103	191
Tremont						9	9		18
Ball & Fitts			2	2			1		5
Star							1		1
	2	11	10	43	6	103	108	137	420

One hundred and seventy-two meters have been taken out especially for test and examination; 12 ordered out as not working satisfactorily; 76 clocks broken, leaking, and various causes.

Meters repaired, 52; repairs consisting of changing clocks, repairing leaks, etc.

Pipes found leaking and repaired, 6; location of meters changed, 3.

Four ¾-in. "B.W.W." meters have been purchased, and the following sent to the factory for repairs: 11 Worthington and 28 Crowns.

Nine new street boxes have been set, 22 decayed taken out and replaced by new; 44 repaired and 78 discontinued, and streets put in good condition.

All outside boxes have been hayed for the winter.

Meter couplings scaled with composition clamps, 253.

General Statement, for the Year.

	COCHITUATE DEPT.			MYSTIC DEPT.		
	Meters.	Boxes.	Pipes.	Meters.	Boxes.	Pipes.
Purchased	496			4		
New set	86	48		25	9	
Discontinued	383	68		77	78	
Changed	1,121			260		
Tested at shop	1,616					
Repaired at shop	197					
Repaired in service	193			52		
Repaired at factory	116			39		
Locations changed	34			3		
Couplings sealed	410			253		
Reset		26			22	
Repaired		29			44	
Repaired leaking			28			6
In service	3,128			420		

Respectfully,
 GEO. S. FOLLANSBEE,
Superintendent.

REPORT OF THE SUPERINTENDENT OF THE INSPECTION AND WASTE DIVISION.

DIVISION OF INSPECTION AND WASTE,
CITY HALL, Jan. 1, 1888.

To HORACE T. ROCKWELL, Esq., Chairman Boston Water Board: —

SIR, — The following report of this division for the year from January 1, 1887, to January 1, 1888, is respectfully submitted.

The inspection force on the 1st January, 1887, consisted of thirty inspectors and three chief inspectors.

On March 21 three inspectors were detailed to work under the Water Registrar of the Mystic Department: they continued there until December 5. In April eleven inspectors were assigned to Water Registrar Davis to inspect the Cochituate Department for the assessing of water-rates; they worked under him until August 1. The remaining sixteen inspectors were engaged during the year checking the waste indicated by the Deacon meters and Church stop-cocks; work was begun on the meters and stop-cocks April 25, and continued until November 26, when the meters were taken up.

Inspector R. E. Maguire resigned in January, and Dillon McCormack, a suspended inspector, was reinstated to fill the vacancy. Another suspended inspector — Solomon Bacharach — was reinstated July 8.

During the summer months the inspection force having all the work they could possibly attend to in the Cochituate and Mystic divisions, five inspectors were temporarily appointed to enforce the ordinance in relation to hand hose, fountains, sprinklers, etc.; they were on duty — three from the beginning of June, and two additional from July 16 to the 1st of November, when their services were dispensed with.

On October 18 the location of the three divisions of inspectors were changed as follows, viz.: the men who had been employed in the Roxbury, Dorchester, West Roxbury, and Brighton districts were transferred to Somerville, Chelsea, Everett, Revere, and Charlestown. The men on duty in the latter districts were placed in the middle district, comprising South Boston and the city proper; those at work in

the city proper were placed in the Roxbury and Brighton districts.

The order issued by the Water Board March 14, to have inspectors state in their daily reports the hour of visit to each premises, has been productive of good results by affording a check on the work of each inspector every hour of the day.

Notwithstanding the facilities afforded by the Deacon meters and Church stop-cocks to check waste, and that nearly 2,000 premises more than the previous year were reported wasting water, the consumption of the year in the Cochituate division averaged 12.28 per cent. over that of 1886. This, I consider, in a great measure, may be the result of increase in population, business premises, and thousands of water-closets ordered in by the Board of Health where vaults previously existed.

The following table shows the consumption in the Cochituate Department for the year, also for the year before inspection began. Notwithstanding increase of population, buildings, and other increased sources of consumption, the figures show a saving of 10.40 per cent., or an average of 3,523,492 gallons for each day of the year, as compared with the year before inspection.

MONTH.	BEFORE INSPECTION.	Average daily Consumption, 1887.	Average daily Saving in 1887, as against Consumption the year before In- spection began.	Per cent. saved as against year before Inspection.
	Average daily Consumption.			
	<i>Gallons.</i>	<i>Gallons.</i>	<i>Gallons.</i>	
	1882-1883.			
January, 1883	34,715,500	32,687,600	2,027,900	5.84
February, "	32,690,700	31,224,400	1,466,300	4.48
March, "	34,110,700	28,124,100	5,986,600	17.55
April, "	30,617,600	25,591,500	5,026,100	16.41
May, "	32,169,500	27,925,000	4,244,500	13.19
June, "	33,419,200	30,069,000	3,350,200	10.02
July, "	36,774,000	30,469,700	6,304,300	17.14
August, "	37,141,000	30,063,100	7,077,900	19.05
September, "	33,645,600	31,946,600	1,699,000	5.04
October, 1882	31,563,800	30,562,700	1,001,100	3.17
November, "	31,318,700	28,062,000	3,256,700	10.37
December, "	32,352,800	31,511,500	841,300	2.6
Averages for each month }	33,376,591	29,853,100	3,523,492	10.40

The following schedule gives the Mystic consumption for the year, as also before inspection began, with the increase or decrease as compared with the consumption of 1886:—

MONTH.	BEFORE INSPECTION.	AFTER INSPECTION.	Increase over Consump- tion of 1886.	Decrease in Con- sumption of 1887 as against that of 1886.
	Average daily Consumption.	Average daily Consumption for 1887.		
	<i>Gallons.</i>			
	1883.			
January	8,369,600	10,488,600	23.2	
February	7,714,700	9,346,700	0.1	
March	7,737,300	8,175,000	5.1	
April	6,171,100	6,933,800	4.5	
May	6,319,100	6,916,300	7.3	
June	6,912,500	7,159,800	3.1	
July	7,307,600	7,250,000		2.5
August	7,261,500	6,871,900		4.1
September	5,846,300	6,877,600		9.3
	1882.			
October	6,011,300	6,436,600		1.8
November	5,577,400	7,361,200	12.5	
December	6,877,600	7,835,300		2.6
Averages	6,842,166	7,637,733		

The following table gives the work performed by each inspector in checking waste :—

INSPECTOR.	No. of Premises Inspected for Waste.	DEFECTIVE FIXTURES.				WILFUL WASTE REPORTS.	
		Reports received.	Notices to repair issued.	Re-examinations made.	Fine notices issued for non-repairs.	Reports received.	Fine notices issued.
Bacharach, S.	2,006	170	188	160	2	.....	.....
Berran, Joseph	3,358	129	117	147	4	.....	.....
Cassidy, M. F. J.	4,394	378	246	358	8	.....	.....
Connolly, John J.	2,322	52	178	136	1	.....	.....
Corbett, John J.	2,979	324	282	375	2	1	1
Daly, James F.	3,425	255	997	1,259	.....	1	1
Desmond, John F.	4,762	241	241	252	10	.....	.....
Dunn, John J.	5,580	594	602	527	7	8	8
Edmonds, Michael F.	5,045	455	421	407	.....	.....	.....
Finnigan, D. A.	5,168	759	764	771	5	.....	.....
Foye, John E.	2,990	137	144	168	12	.....	.....
Hassett, John B.	4,602	478	466	450	2	1	1
Kane, James J.	3,400	833	875	744	26	.....	.....
Kilduff, William	4,991	640	613	578	8	1	1
McCarty, C. F.	5,244	508	450	398	2	.....	.....
McCarthy, T., jr.	1,445	369	86	19	4	.....	.....
McCormack, D.	3,095	186	174	163	7	.....	.....
McNamara, John J.	3,475	156	137	163	.....	.....	.....
Maguire, Hugh	2,933	69	73	70	.....	.....	.....
Murphy, John J.	4,519	575	530	772	42	.....	.....
Murray, Thos. F.	4,271	584	542	727	12	.....	.....
Neagle, Joseph B.	1,436	673	588	381	43	.....	.....
Quigley, John J.	3,301	173	157	42	3	.....	.....
Quigley, James L.	1,203	301	51	55	.....	.....	.....
Ross, George F.	4,797	533	478	465	19	9	9
Rosnosky, R.	3,093	206	159	64	15	.....	.....
Roth, John H.	1,716	864	770	499	49	1	1
Smith, Lawrence	3,504	504	484	619	2	.....	.....
Sweeny, C. F.	1,186	190	29	18	1	.....	.....
Toland, Joseph H.	4,138	58	58	35	.....	.....	.....
Wood, Walter B.	5,093	499	474	452	24	.....	.....
	109,471	11,893	11,314	11,274	310	22	22

During the year 340 fines were inflicted for non-repairs of water-fixtures, wilful waste, and violations of hose regulations. Of these only 5 were collected; 335 were abated for various causes, in most cases the persons fined being allowed additional time to comply with the ordinances to make repairs, etc.

During the same period the water has been cut off for non-payment of fines, etc., from one water-taker and let on again to one.

The amount of cash received for fines and turned over to the City Collector was \$10, viz. : —

Cochituate Department	.	.	.	.	.	\$8 00
Mystic Department	.	.	.	.	.	2 00
						\$10 00

Respectfully submitted,

D. B. CASHMAN,
Superintendent.

SUMMARY OF STATISTICS.

REPORT OF 1887.

IN ACCORDANCE WITH THE RECOMMENDATION OF THE NEW
ENGLAND WATER-WORKS ASSOCIATION.

Boston Water-Works, Suffolk County, Massachusetts, supplies also the cities of Somerville and Chelsea, and the town of Everett.

Population by census of 1885 : —

Boston	390,393
Chelsea	25,709
Somerville	29,971
Everett	5,825
Total	451,898

Date of construction : —

Cochituate works	1848
Mystic “	1864

By whom owned. — City of Boston.

Sources of supply. — Lake Cochituate, Sudbury River, and
Mystic Lake.

Mode of supply. — Seventy per cent. from gravity works.
Thirty “ “ “ pumping “

PUMPING.

COCHITUATE.

MYSTIC.

Builder of pump- { H. R. Worthington. H. R. Worthington.
ing machinery, { Boston Machine Co.

Description of coal used : —

<i>a</i> Kind, —	Anthracite,	Bituminous.
<i>c</i> Size, —	Furnace,	Broken.
<i>e</i> Price per gross ton,	\$4.94 to \$5.87	\$3.86 and \$4.29.
<i>f</i> Per cent. of ash, —	15.5	8.9.

	COCHITUATE.	MYSTIC.
Coal consumed for year in lbs.,	2,541,900	6,007,900
Total pumpage for year in galls.,	1,255,981,200	2,784,653,100
Average dynamic head in feet,	115.88	147.73
Gallons pumped per lb. of coal,	494.1	463.5
Duty in foot lbs. per 100 lbs. of coal (no deductions)	47,752,800	57,106,200

Cost of pumping figured on pumping-station expenses, viz. : —	\$12,153.60	\$21,761.72
Cost per million gallons raised to reservoir	\$9.68	\$7.81
Cost per million gallons raised one foot high	\$0.0835	\$0.0529

CONSUMPTION.

	COCHITUATE.	MYSTIC.
Estimated population	370,000	105,000
Estimated population sup- plied	360,000	103,000
Total consumption, gallons	10,896,008,000	2,784,595,000
Passed through domestic meters	280,785,000	12,911,250
Passed through manufactur- ing meters	2,358,052,500	442,678,400
Average daily consumption, gallons	29,852,100	7,629,000
Gallons per day, each in- habitant	80.8	72.7
Gallons per day, each con- sumer	82.9	74.1
Gallons per day to each tap,	540	454

DISTRIBUTION.

	COCHITUATE. Cast-Iron.	MYSTIC. Cast-Iron, Wrought-Iron, and Cement.
MAINS.		
Kind of pipe used : —		
Size	48-in. to 4-in.	30-in. to 3-in.
Extended, miles	22.36	4.51
Total now in use	436.50	137.76
Distribution pipes less than 4-in., length, miles	0	6.2
Hydrants added	184	43
Hydrants now in use	4,990	935
Stop-gates added	249	65
Stop-gates now in use	4,667	1,301

SERVICES.	COCHITUATE.	MYSTIC.
	Lead.	Lead and Wrought-Iron.
Kind of pipe used : —		
Size	$\frac{5}{8}$ -in. to 2-in.	$\frac{1}{2}$ -in. to 2-in.
Extended, feet . . .	53,995	21,851
Service taps added . .	1,835	694
Total now in use . . .	55,235	16,804
Meters discontinued . .	301	49
Meters now in use . . .	3,114	420
Motors and elevators in use	365	8

FINANCIAL. COCHITUATE WORKS. — MAINTENANCE.

Receipts.		Expenditures.	
DIVISION I.			
From consumers : —		Maintenance.....	\$341,693 34
Water-rates, domestic.....	\$605,297 06	Refunded water-rates.....	553 59
“ “ manufacturing.....	527,333 65	Interest.....	721,584 76
Miscellaneous, sales, etc.	31,106 57	Total maintenance.....	\$1,063,831 69
	<u>\$1,163,737 28</u>	Balance to sinking-fund	211,466 63
From public funds : —			
Hydrants.....	\$83,610 00		
Fountains.....	000 00		
Street-sprinkling.....	000 00		
Public buildings.....	27,931 04		
	<u>111,561 04</u>		
Total receipts.....	<u>\$1,275,298 32</u>		<u>\$1,275,298 32</u>
DIVISION II.		Construction.	
From fixed rates : —		New main to East Boston	\$33,151 94
Domestic.....	\$554,999 66	Extension of mains.	201,237 58
Manufacturing.....	237,857 00	“ “ services.....	36,405 00
	<u>\$792,856 66</u>	Setting sidewalk stop-cocks.....	32,127 35
		New high-service works.....	160,866 80
		Additional supply	40,078 62
From meter-rates : —		Sidewalk stop-cocks (transfer from special appropriation)	50,000 00
Domestic.....	50,297 40	Total construction for year.....	\$553,867 29
Manufacturing.....	401,037 69	Total cost of construction to date.....	\$19,527,483 32
	<u>\$1,244,191 75</u>		

FINANCIAL.

MYSTIC WORKS. — MAINTENANCE.

Receipts.		Expenditures.	
DIVISION I.			
From consumers : —		Management and repairs	\$153,345 02
Water-rates, domestic	\$177,118 19	Interest	44,927 50
“ “ manufacturing	100,411 46	Refunded water-rates	470 83
Miscellaneous	2,178 34	Water-rates refunded to Chelsea, Somerville, and Everett.	83,903 64
	<u>\$279,707 99</u>		
From public funds : —		Total maintenance	\$282,646 99
Hydrants	\$8,598 00	Balance to sinking-fund	12,550 00
Street-watering	3,925 09		
Public buildings	2,965 91		<u>\$295,196 99</u>
	<u>15,489 00</u>		
Total receipts	<u>\$295,196 99</u>		
DIVISION II.		Construction.	
From fixed rates : —		Extension of mains	\$2,180 40
Domestic	\$174,724 14	Total construction for year	\$2,180 40
Manufacturing	42,052 69	Total cost of construction to date	\$1,659,639 37
	<u>\$216,776 83</u>		
From meter-rates : —			
Domestic	2,394 05		
Manufacturing	73,847 77		
	<u>\$293,018 65</u>		
Total receipts for water			

CIVIL ORGANIZATION OF THE WATER-WORKS, FROM THEIR COMMENCEMENT TO JANUARY 1, 1888.

WATER COMMISSIONERS.

NATHAN HALE, JAMES F. BALDWIN, THOMAS B. CURTIS. From May 4, 1846, to January 4, 1850.

ENGINEERS FOR CONSTRUCTION.

JOHN B. JERVIS, of New York, Consulting Engineer. From May, 1846, to November, 1848.‡

E. S. CHESBROUGH, Chief Engineer of the Western Division. From May, 1846, to January 4, 1850.‡

WILLIAM S. WHITWELL, Chief Engineer of the Eastern Division. From May, 1846, to January 4, 1850.

CITY ENGINEERS HAVING CHARGE OF THE WORKS.

E. S. CHESBROUGH, Engineer. From November 18, 1850, to October 1, 1855.‡

GEORGE H. BAILEY, Assistant Engineer. From January 27, 1851, to July 19, 1852.

H. S. MCKEAN, Assistant Engineer. From July 19, 1852, to October 1, 1855.

JAMES SLADE, Engineer. From October 1, 1855, to April 1, 1863.

N. HENRY CRAFTS, Assistant Engineer. From October 1, 1855, to April 1, 1863.

N. HENRY CRAFTS, City Engineer. From April 1, 1863, to November 25, 1872.

THOMAS W. DAVIS, Assistant Engineer. From April 1, 1863, to December 8, 1866.

HENRY M. WIGHTMAN, Resident Engineer at C. H. Reservoir. From February 14, 1866, to November, 1870.‡

A. FTELEY, Resident Engineer on construction of Sudbury-river works. From May 10, 1873, to April 7, 1880.

JOSEPH P. DAVIS, City Engineer. From Nov. 25, 1872, to March 20, 1880.

HENRY M. WIGHTMAN, City Engineer. From April 5, 1880, to April 3, 1885.‡

WILLIAM JACKSON, City Engineer. From April 21, 1885, to present time.

After January 4, 1850, Messrs. E. S. CHESBROUGH, W. S. WHITWELL, and J. AVERY RICHARDS were elected a Water Board, subject to the direction of a Joint Standing Committee of the City Council, by an ordinance passed December 31, 1849, which was limited to keep in force one year; and in 1851 the Cochituate Water Board was established.

COCHITUATE WATER BOARD.

Presidents of the Board.

THOMAS WETMORE, elected in 1851, and resigned April 7, 1856‡ Five years.

JOHN H. WILKINS, elected in 1856, and resigned June 5, 1860‡ Four years.

EBENEZER JOHNSON, elected in 1860, term expired April 3, 1865†	Five years.
OTIS NORCROSS, elected in 1865, and resigned January 15, 1867†	One year and nine months.
JOHN H. THORNDIKE, elected in 1867, term expired April 6, 1868†	One year and three months.
NATHANIEL J. BRADLEE, elected April, 6, 1868, and resigned January 4, 1871	Two years and nine months.
CHARLES H. ALLEN, elected January 4, 1871, to May 4, 1873	Two years and four months.
JOHN A. HAVEN, elected May 4, 1873, to Dec. 17, 1874†	One year and seven months.
THOMAS GOGIN, elected Dec. 17, 1874, and resigned May 31, 1875	Six months.
L. MILES STANDISH, elected August 5, 1875, to July 31, 1876	One year.

Members of the Board.

THOMAS WETMORE, 1851, 52, 53, 54, and 55†	Five years.
JOHN H. WILKINS, 1851, 52, 53, *56, 57, 58, and 59†	Eight years.
HENRY B. ROGERS, 1851, 52, 53, *54, and 55†	Five years.
JONATHAN PRESTON, 1851, 52, 53, and 56†	Four years.
JAMES W. SEAVER, 1851†	One year.
SAMUEL A. ELIOT, 1851†	
JOHN T. HEARD, 1851†	One year.
ADAM W. THAXTER, Jr., 1852, 53, 54, and 55†	Four years.
SAMPSON REED, 1852 and 1853†	Two years.
EZRA LINCOLN, 1852†	One year.
THOMAS SPRAGUE, 1853, 54, and 55†	Three years.
SAMUEL HATCH, 1854, 55, 56, 57, 58, and 61	Six years.
CHARLES STODDARD, 1854, 55, 56, and 57†	Four years.
WILLIAM WASHBURN, 1854 and 55	Two years.
TISDALE DRAKE, 1856, 57, 58, and 59†	Four years.
THOMAS P. RICH, 1856, 57, and 58†	Three years.
JOHN T. DINGLEY, 1856 and 59†	Two years.
JOSEPH SMITH, 1856†	Two months.
EBENEZER JOHNSON, 1857, 58, 59, 60, 61, 62, 63, and 64†	Eight years.
SAMUEL HALL, 1857, 58, 59, 60, and 61†	Five years.
GEORGE P. FRENCH, 1859, 60, 61, 62, and 63†	Five years.
EBENEZER ATKINS, 1859†	One year.
GEORGE DENNIE, 1860, 61, 62, 63, 64, and 65	Six years.
CLEMENT WILLIS, 1860	One year.
G. E. PIERCE, 1860†	One year.
JABEZ FREDERICK, 1861, 62, and 63†	Three years.
GEORGE HINMAN, 1862 and 63	Two years.
JOHN F. PRAY, 1862	One year.
J. C. J. BROWN, 1862	One year.
JONAS FITCH, 1864, 65, and 66†	Three years.
OTIS NORCROSS, *1865 and 66†	Two years.
JOHN H. THORNDIKE, 1864, 65, 66, and 67†	Four years.
BENJAMIN F. STEVENS, 1866, 67, and 68	Three years.
WILLIAM S. HILLS, 1867	One year.
CHARLES R. TRAIN, 1868†	One year.
JOSEPH M. WIGHTMAN, 1868 and 69†	Two years.
BENJAMIN JAMES, *1858, 68, and 69	Three years.
FRANCIS A. OSBORN, 1869	One year.
WALTER E. HAWES, 1870†	One year.
JOHN O. POOR, 1870	One year.
HOLLIS R. GRAY, 1870	One year.

NATHANIEL J. BRADLEE, 1863, 64, 65, 66, 67, 68, 69, 70, and 71	Nine years.
GEORGE LEWIS, 1868, 69, 70, and 71†	Four years.
SIDNEY SQUIRES, 1871†	One year.
CHARLES H. HERSEY, 1872	One year.
CHARLES H. ALLEN, 1869, 70, 71, and 72	Four years.
ALEXANDER WADSWORTH, *1864, 65, 66, 67, 68, 69, and 72	Seven years.
CHARLES R. McLEAN, 1867, 73, and 74†	Three years.
EDWARD P. WILBUR, 1873 and 74	Two years.
JOHN A. HAVEN, 1870, 71, 72, 73, and 74†	Five years.
THOMAS GOGIN, 1873, 74, and 75*	Three years.
ANOS L. NOYES, 1871, 72, and 75	Three years.
WILLIAM G. THACHER, 1873, 74, and 75†	Three years.
CHARLES J. PRESCOTT, 1875	One year.
EDWARD A. WHITE, 1872, 73, 74, 75, and 76†	Five years.
LEONARD R. CUTTER, 1871, 72, 73, 74, 75, and 76†	Six years.
L. MILES STANDISH, 1860, 61, 63, 64, 65, 66, 67, 74, 75, and 76†	Ten years.
CHARLES E. POWERS, *1875 and 1876†	Two years.
SOLOMON B. STEBBINS, 1876†	One year.
NAHUM M. MORRISON, 1876†	One year.
AUGUSTUS PARKER, 1876†	One year.

*Mr. John H. Wilkins resigned Nov. 15, 1855, and Charles Stoddard was elected to fill the vacancy. Mr. Henry B. Rogers resigned Oct. 22, 1865. Mr. Wilkins was re-elected Feb., 1856, and chosen President of the Board, which office he held until his resignation, June 5, 1860, when Mr. Ebenezer Johnson was elected President; and July 2 Mr. L. Miles Standish was elected to fill the vacancy occasioned by the resignation of Mr. Wilkins. Otis Norcross resigned Jan. 15, 1867, having been elected Mayor of the City. Benjamin James served one year, in 1858, and was reelected in 1868. Alexander Wadsworth served six years, 1864-69, and was reelected in 1872. Thomas Gogin resigned May 31, 1875. Charles E. Powers was elected July 15, to fill the vacancy occasioned by the resignation of Mr. Gogin.

† Served until the organization of the Boston Water Board.

‡ Deceased.

BOSTON WATER BOARD, *Organized July 31, 1876.*

TIMOTHY T. SAWYER, from July 31, 1876, to May 5, 1879; and from May 1, 1882, to May 4, 1883.

LEONARD R. CUTTER, from July 31, 1876, to May 4, 1883.

ALBERT STANWOOD, from July 31, 1876, to May 7, 1883.

FRANCIS THOMPSON, from May 5, 1879, to May 1, 1882.†

WILLIAM A. SIMMONS, from May 7, 1883, to Aug. 18, 1885.

GEORGE M. HOBBS, from May 4, 1883, to May 4, 1885.

JOHN G. BLAKE, from May 4, 1883, to Aug. 18, 1885.

WILLIAM B. SMART, from May 4, 1885, to present time.

HORACE T. ROCKWELL, from Aug. 25, 1885, to present time.

THOMAS F. DOHERTY, from Aug. 26, 1885, to present time.

ORGANIZATION OF THE BOARD FOR YEAR 1887.

Chairman.

HORACE T. ROCKWELL.

Clerk.

WALTER E. SWAN.

City Engineer and Engineer of the Board.

WILLIAM JACKSON.

Water Registrar.

WILLIAM F. DAVIS.

Deputy Collector and Clerk, Mystic Department.

JOSEPH H. CALDWELL.

Superintendent of the Eastern Division of Cochituate Department.

EZEKIEL R. JONES.

Superintendent of the Western Division of Cochituate Department.

DESMOND FITZGERALD.

Superintendent of Mystic Department.

J. HENRY BROWN.

Superintendent of Meter Division.

GEORGE S. FOLLANSBEE.

Superintendent of Inspection and Waste Division.

D. B. CASHMAN.

† Deceased.

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